NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Plant Science

"CONFIRMED"
Dean of the agrobiological faculty
_____ O. L. Tonkha
"___" _____ 2023

"APPROVED"
at the meeting of the department of Plant Science
Protocol №20 dated "21" Aprill 2023 y.
Head of Department
_____ S. M. Kalenska

"REVIEWED"
Program Coordinator
_____ O. L. Tonkha

PROGRAM OF THE COURSE

PLANT SCIENCE

Specialization	201 Agronomy
Educational program	Agronomy
Faculty	Agrobiological
Developers:	prof., Doctor of Agricultural Sciences Kalenska S.M.

Kyiv – 2023 y.

1. Description of the course

PLANT SCIENCE

Field of knowledge, specialization, educational program, educational degree		
Educational degree	**Bachelor's**	
Specialization	**201 Agronomy**	
Educational program	**Agronomy**	
Characteristics of the course		
Type	Compulsory	
Total number of hours	270	
Number of ECTS credits	9	
Number of content modules	6	
Course project (work) (if applicable)	yes	
Form of assessment	*Exam*	
Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	2-3	4-5
Semester	3-5	8-9
Lecture classes	*90 hr.*	*36 hr.*
Practical, seminar classes	*105 hr.*	*40 hr.*
Laboratory classes	*- hr.*	*- hr.*
Self-study	*75 hr.*	*194 hr.*
Individual assignments	*- hr.*	*- hr.*
Number of weekly classroom hours for the full-time form of study	*4/6/3 hr.*	4/2

2. Purpose, objectives, and competencies of the course

Purpose 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.

The ability of each student to clearly understand the significance and necessity of mastering the content of the educational material is one of the primary tasks set before the instructors. It is necessary to create or improve the existing motivational basis for the future specialist's learning and cognitive activities.

The implementation of intensive technologies for the cultivation of field crops depends significantly on the professional training of specialists in the agro-industrial sector. Modern agrotechnologies, unlike previous ones, are characterized not only by significantly higher energy intensity but also by stricter requirements for the implementation of agrotechnical practices that are part of these technologies. The situation is further complicated by the fact that in recent years, so-called high-intensity varieties have gained wide popularity. Their plants can unleash their genetic potential only when the conditions of the surrounding environment closely approximate their biological requirements. Violations of the regulations for the use of chemical means to control weeds, diseases, and pests have a particularly negative impact on yield formation. It is known that cultivated plants can safely neutralize pesticide compounds only during certain phases of their growth and development.

Objectives of the educational discipline that need to be addressed during its study are as follows:

- Studying the state of the crop production industry and ways to intensify the sector.
- Substantiating the fundamental laws and general regularities of the interconnection of plant life factors, their significance in the practical activities of professionals.
- Studying a brief history of crops, the biological peculiarities of major agricultural crops, their importance, and distribution.
- Justifying and understanding the formative processes of crops based on the main stages of organogenesis and phases of development to manage the processes of achieving high yields and product quality.
- Independently scientifically substantiating a complex of agrotechnological techniques for cultivating crops in a unified technological process specific to a particular soil and climatic zone.
- Upon completion of the discipline, the student should know: the state and prospects of crop production, the morphological and biological characteristics of field crops, modern cultivation technologies, including intensive methods; ways and methods to improve the quality of agricultural products and reduce labor and resource costs in crop cultivation.

During the study of the discipline, the professional should **be able to:**

- Plan and organize the execution of agricultural processes using agricultural machinery, fertilizers, and pesticides.
- Apply scientific advancements and best practices.
- Program crop yields.
- Plan the production of high-quality, environmentally friendly products with minimal energy and labor inputs, maximizing output per unit of time and unit of area.
- Implement variety selection, intensive, energy- and resource-efficient, and ecologically sound technologies.
- Apply timely and effective crop rotation and rational crop placement in crop rotation to improve cultivation conditions.

- Combine intensive crop production with a complex of agrotechnical, agrochemical, and land improvement measures to preserve and restore soil fertility and crop production based on modern, highly productive agricultural machinery and its efficient operation.
- Prevent crop losses during cultivation, harvesting, and transportation.
- Use real-time information for timely and quality implementation of agricultural activities, prevention and resolution of negative situations in crop production.

Acquisition of competencies:

Integrated competency (IC): The ability to solve complex specialized tasks and practical problems in agronomy, which involves the application of theories and methods of the relevant science and is characterized by comprehensiveness and suitability to zonal conditions.

General competencies (GC):

GC 7. The ability to apply knowledge in practical situations.

GC 11. A commitment to environmental preservation.

Professional (special) competencies (PC):

PC 2. The ability to grow, propagate agricultural crops, and carry out technological operations related to primary processing and storage of agricultural products.

PC 6. The ability to apply methods of statistical data analysis related to technological and breeding processes in agronomy

PC 9. Skills in managing complex actions or projects, taking responsibility for decision-making in specific production conditions.

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Program learning outcomes (PLO):

PLO 6: Analyze and integrate knowledge from general and specialized professional training to the extent necessary for specialized professional work in the field of agronomy.

PLO 9: Possess operational-level methods of observation, description, identification, as well as cultivation of objects and maintaining the stability of agroecosystems while preserving natural diversity.

PLO 11: Initiate timely and appropriate solutions to production problems in accordance with zonal conditions.

PLO 13: Design and organize measures for the cultivation of high-quality agricultural products.

PLO 15: Plan economically viable production of agricultural products.

3. **Program and structure of the course for:**
– complete full-time (part-time) form of study;
– shortened full-time (part-time) form of study.

Names of content modules and topics	Number of hours												
	Full-time form							Part-time form					
	weeks	total	including					total	including				
			l	p	lab	ind	self		l	p	lab	ind	self
1	2	3	4	5	6	7	8	9	10	11	12	13	14
CONTENT MODULE 1 – TEORETICAL BASIS OF CROP PRODUCTION													
1. Crop production as a branch of agricultural production.		2	2					4					4
2. Ecological and biological foundations of crop production.		2	2					4					4
3. Agrobiological foundations of intensive cultivation technologies for agricultural crops.		4	2				2	10	2				8
4. Agrotechnological foundations of crop production.		4	2				2	10	2				8
5. Fundamentals of crop yield programming.		8	2	6				6		2			4
6. Fundamentals of seed science.		8	2	6				6		2			4
Total for content module 1		**28**	**12**	**12**			**4**	**40**	**4**	**4**			**32**
CONTENT MODULE 2 – CEREALS AND LEGUMES													
1. Winter cereals		38	12	16			10	40	6	8			26
2. Spring cereals and flake crops		38	14	16			8	36	6	6			24
3. Legumes		32	12	10			10	30	4	4			22
Total for content module 2		**108**	**38**	**42**			**28**	**108**	**18**	**18**			**72**
CONTENT MODULE 3 – ROOT CROPS, TUBER CROPS, WATERMELONS													
1. Tuber crops		10	2	4			4	12	2	2			8
2. Root crops		9	2	3			4	12	2	2			8
3. Watermelons		6	2	2			2	8		2			6
Total for content module 3		**25**	**6**	**9**			**10**	**32**	**4**	**6**			**22**
CONTENT MODULE 4 – SUGAR BEETS													
1. Sugar crops		8	2	2			4	12	2	2			8

2. Sugar beets		16	6	6			4	16	2	2			12
Total for content module 4		**24**	**8**	**8**			**8**	**28**	**4**	**4**			**20**
CONTENT MODULE 5 – OILSEEDS AND ESSENTIAL OIL CROPS													
1. Oilseeds		32	10	10			12	14	2	2			10
2. Essential oil crops		15	4	8			3	24	2	2			20
Total for content module 5		**47**	**14**	**18**			**15**	**38**	**4**	**4**			**30**
1	2	3	4	5	6	7	8	9	10	11	12	13	14
CONTENT MODULE 6 – FIBER, AROMATIC, MEDICINAL AND ENERGY CROPS													
1. Fiber crops		12	6	4			2	10	2	2			6
2. Aromatic crops		8	2	4			2	4					4
3. Medicinal crops		9	2	4			3	4					4
4. Energy crops		9	2	4			3	6		2			4
Total for content module 6		**38**	**12**	**16**			**10**	**24**	**2**	**4**			**18**
Coursework on Crop Production: "Development and Scientific Justification of a Technology for Cultivating a Programmed Yield of Agricultural Crops under Specific Soil and Climatic Conditions»			**-**	**-**	**-**		**-**		**-**	**-**	**-**		**-**
УСЬОГО ГОДИН		**270**	**90**	**105**			**75**	**270**	**36**	**40**			**194**

4. Seminar topics

№	Topic title	Number of hours
1	Not provided	
2		
...		

5. Practical class topics

№	Topic title	Number of hours
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
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
15	Sorghum. Botanical characteristics. Systematics and morphology. Economic and biological characteristics of groups, varieties, and hybrids.	2
16	Rice. Systematics and morphological characteristics. Features of root system structure. Subspecies, groups, varieties. Varieties.	2
17	Buckwheat. Systematics and morphology of plants. Determination of species and varieties. Economic and biological characteristics of varieties.	2
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.	2
19	General characteristics of cereal legume crops. Morphological features. Identification of cereal legume crops based on seeds, seedlings, leaves, and fruits.	2
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	2

	characteristics.	
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
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
39	Botanical-morphological characteristics of essential oil crops.	8
40	Bast fiber crops. Botanical-morphological characteristics of flax.	2
41	Botanical-morphological characteristics of hemp, cotton, and	2

	kenaf.	
42	Botanical-morphological characteristics of tobacco, snuff, and hops.	4
43	Botanical-morphological characteristics of medicinal crops.	4
44	Botanical-morphological characteristics of phytoenergy crops.	4
	Total	**105**

6. Laboratory class topics

№	Topic title	Number of hours
1	Not provided	
2		
...		

7. Independent work topics

№	Topic title	Number of hours
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
6	Winter cereals. General characteristics.	8
7	Spring cereals and cereal crops.	8
8	Grain legume crops.	8
9	Tuber crops.	4
10	Root crops.	3
11	Vegetable crops.	2
12	Sugar crops.	2
13	Sugar beets.	6
14	Oil crops.	8
15	Essential oil crops.	8
16	Fiber crops.	2
17	Aromatic crops.	2
18	Medicinal plants.	2
19	Phytoenergy crops.	2
	Total	**75**

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

Form № N-5.05
F-7.5-2.1.6-24

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCE OF UKRAINE

QL «Bachelor» Educational program «**Agronomy**»	**Department of Plant Science** 2023-2024 educational year	**EXAM TICKET #1** Discipline: **Plant sciense**	**Approved** Head of department _____ (sign) Kalenska S.M. _____ 2023

Exam questions (essay – 100-200 words) – Екзаменаційні запитання

1. **Technology of soybean cultivation** (*Технологія вирощування сої)*
2. **Biological peculiarities of sunflower** (*Біологічні особливості соняшнику*)

Tests

1.	**Mais(corn) forms two types of inflorescences. There are …** (Назвіть 2 види суцвіть у кукурудзи)
A	**Ear/spike** (колос)
B	**Corncob** (початок)
C	**Panicle** (волоть)
D	**Flowerhead** (кошик)_

2.	**Fruit of family Fabaceae (Legumes) is.** (Плід бобових це…)
A	**Caryopsis** (зернівка)
B	**Pod/pulse** (біб)
C	**Silicle** (стручок)

3.	**Root vegetables(taproots, example sugar beet) is … crops** (Коренеплоди за циклом розвитку це…)
A	**Annial** (однорічні)
B	**Biennial** (дворічні)
C	**Perennial** (багаторічні)

4.	**High oil content (more 30 %) forms in seed of:** (Високий вміст олії в зерні у …)
A	**Wheat** (пшениця)
B	**Mais** (кукурудза)
C	**Soja** (соя)

5. **Cereals have a low oil contents in seeds. (*True or false*)**

6.	**Essential oils in fennel and anise are containing in** (ефірна олія в анісу та фенхелю міститься в)
A	**Stem/sprout** (пагін/стебло)
B	**Seed** (насіння)
C	**Inflorescence** (суцвіття)
D	**Root** (корінь)

7.	**Fruit of Cereals (fam. *Graminea*) is.** (Плід злакових це…)
A	**Caryopsis** (зернівка)
B	**Pod/pulse** (біб)
C	**Silicle** (стручок)

8.	**Stem of cereals is** (Коренеплоди за циклом розвитку це…)
A	**Strow** (соломина)
B	**Vine** (лоза/ліана)
C	**Tuber** (бульба)

9.	**High oil content (more 30 %) forms in seed of:** (Високий вміст олії в зерні у …)
A	**Wheat** (пшениця)
B	**Mais** (кукурудза)
C	**Sunflower** (соняшник)

10. **Flax (*Linum*) cultivating for fiber and seeds. (*True or false*)**

9. Teaching methods.

Methods of organization and implementation of teaching and learning of students who used to study subjects:

1. in terms of transmission and perception of educational information :
   - verbal (lecture);
   - visual (illustration , demonstration);
   - practical (laboratory work);
2. in terms of logic and thinking:
   - explanatory, illustrative (presentation);
   - reproductive (short test papers);
3. in terms of management training:
   - job training under the supervision of a teacher;
   - independent work;
4. in terms of a team:
   - incentives (extra points for abstracts);
5. aspect of self-employment:
   - Training Module : structural logic scheme;
   - sample tests

10. Forms of assessment

Forms of control students used to the discipline: Current, landmark and final control. ***Current control*** knowledge is an integral part of the whole educational process and serves as a means of identifying the degree of perception (learning) training material. Learning management is possible only on the basis of the current control. The tasks are reduced to the current control order:

- identify the scope, depth and quality perception (mastering) of the material being studied;
- identify deficiencies in knowledge and identify ways to address them;
- identify the degree of responsibility of students and their attitudes to work, finding the causes that hinder their work;
- identify the level of mastering the skills of independent work and identify ways and means of development;
- stimulate students' interest in the subject and in the knowledge of their activity.

The main task of this control - to help students organize their work, learn independently, responsibly and systematically study all subjects.

Block (thematic, modular) control of knowledge is an indicator of quality study of selected chapters and topics related cognitive, methodological, psychological and organizational qualities of students.

Final control is carried out with students to assess their knowledge and skills in the discipline. The main goal - establishing actual content in terms of student learning, the quality and depth of skills and apply them in practice. Final control. In the discipline we apply a differentiated final control of exhibiting total points for the educational process and final control.

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	**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 $\mathbf{R_{dis}}$ (up to 100 points), the rating from the exam $\mathbf{R_{ex}}$(up to 30 points) is added to the rating of a student's academic work $\mathbf{R_{aw}}$ (up to 70 points): $\mathbf{R_{dis} = R_{aw} + R_{ex}}$ **.**

12. Educational and methodological support.

1. Program of course PLANT SCIENCE
2. eLearn – https://elearn.nubip.edu.ua/course/view.php?id=24
3. Metodical recommendation for course work PLANT SCIENCE

13. Recommended sources of information

1. *CROP PRODUCTION GUIDE AGRICULTURE. Tamil Nadu Agricultural University. Link: https://www.freebookcentre.net/biology-books-download/gotoweb.php?id=13855*
2. 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
3. Kalenska S.M., Dmytryshak M.Ya., Mokriyenko V.A. Zernovi ta zernobobovi kultury. Navchalnyi posibnyk. - Vinnytsia: TOV "TVORY". 2020. 366 p. (Title: Cereals and Legume Crops. Educational Manual)
4. Mazur V.A., Polishchuk I.S., Tekalo N.V., et al. Roslynnytstvo. Navchalnyi posibnyk. – Vinnytsia: TOV "Druk". 2020. 352 p. (Title: Crop Production. Educational Manual)
5. 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)
6. Roslynnytstvo z osnovamy kormovyrobnytstva ta agrometeorolohii. Chastyna 1: pidruchnyk/ S.M. Kalenska, M.Ya. Dmytryshak, V.A. Mokriyenko, et al. – Kyiv: Printeko, 2023. 610 p. (Title: Crop Production with Basics of Forage Production and Agrometeorology. Part 1: Textbook)

Additional sources of information

1. Crop production manual. FAO. 2020. Available at: https://www.fao.org/3/ca7556en/CA7556EN.pdf
2. Statistics in Agriculture. Available at: https://fao.org/faostat
3. Ministry of Agriculture Politics http://www.minagro.kiev.ua/
4. Technology of cultivation (field crops) http://agro-business.com.ua/
5. Technology of cultivation (field crops) https://www.agronom.com.ua/