

Appx 2

to the Order of March 23, 2023 № 244

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

Department of Genetics, Breeding and Seed Rising named after
Professor Zelensky M.O.

“CONFIRMED”
Dean of the Agrobiological Faculty
O. Tonkha
Protocol № 4 dated “18” 05 2023 p.

“APPROVED”
at the meeting of the department of Genetics,
Breeding and Seed Rising named
after Professor Zelensky M.O
Protocol № 10 “A” 05 2023 p.
Head of Department O. Makarchuk

“REVIEWED”
Program Coordinator EP «Agronomy»
Program Coordinator O. Tonkha

PROGRAM OF THE COURSE

GENETICS

Specialization 201 Agronomy
Educational program Agronomy
Faculty (Institute) Agrobiological
Developers: Zaika Ye.V., Candidate of Agricultural Sciences, senior lecturer

Kyiv – 2023 p.

1. Description of the course **Genetics**

Field of knowledge, specialization, educational program, educational degree		
Educational degree	<i>Bachelor's</i>	
Specialization	<i>201 Agronomy</i>	
Educational program	<i>Agronomy</i>	
Characteristics of the course		
Type	<i>Compulsory</i>	
Total number of hours	<i>120</i>	
Number of ECTS credits	<i>4</i>	
Number of content modules	<i>3</i>	
Course project (work) (if applicable)	-	
Form of assessment	<i>Exam</i>	
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)	<i>2</i>	-
Semester	<i>1</i>	-
Lecture classes	<i>30 hr.</i>	-
Practical, seminar classes	<i>30 hr.</i>	-
Laboratory classes	-	-
Self-study	<i>60 hr.</i>	-
Individual assignments	-	-
Number of weekly classroom hours for the full-time form of study	<i>4 hr.</i>	-

2. Purpose, objectives, and competencies of the course

Purpose the formation of students' modern ideas about the laws of heredity and variability at different levels of the organization of living matter, ways of their practical use in breeding and seed production.

Objectives expansion of knowledge about the main modern genetic concepts and processes, which are necessary for practical selection work and scientific work in research institutions, formation of skills that allow obtaining theoretical and practical knowledge in the analysis of genetic tasks and problems.

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 complexity and compliance with zonal conditions.

General competencies (GC):

GC 3. Ability to abstract thinking, analysis and synthesis;

GC 6. Knowledge and understanding of the subject area and understanding of professional activity;

GC 8. Skills of performing safe activities.

Professional (special) competencies (PC):

PC 3. Knowledge and understanding of basic biological and agrotechnological concepts, rules and theories related to the cultivation of agricultural and other plants;

PC 5. The ability to evaluate, interpret and synthesize theoretical information and practical, production and research data in the fields of agricultural production;

PC 6. Ability to apply methods of statistical processing of experimental data related to technological and selection processes in agronomy.

Program learning outcomes (PLO):

PLO 3. Discuss and explain the basics that contribute to the development of general political culture and activity, the formation of national dignity and patriotism, socialization of the individual, inclination to ethical values, knowledge of economics and law. (GC 3, GC 6)

PLO 5. Conduct a literature search in Ukrainian and foreign languages and analyze the received information. (GC 6)

PLO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary to possess relevant skills in the field of agronomy. (GC 6)

PLO 7. Demonstrate knowledge and understanding of the principles of physiological processes of plants to the extent necessary for mastering fundamental and professional disciplines. (PC 5)

PLO 8. To have statistical methods of data processing in agronomy. (PC 3)

PLO 11. Initiate prompt and expedient solutions to production problems in accordance with zonal conditions. (GC8, PC 6)

PLO 12. To design and organize the technological processes of growing seed material of agricultural crops in accordance with the established requirements. (GC 8, PC 6)

PLO 16. Organize effective and safe working conditions. (PC 3)

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					
			1	p	lab	ind	self		1	p	lab	ind	self	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Content Module 1.														
LECTURE 1.	1	13	2	2			5							

Subject, methods and history of genetics													
LECTURE 2 - 3. Molecular genetic bases of heredity	2,3	13	4	4			5						
LECTURE 4-5. Genes and chromosomes. DNA damage and repair	4,5	13	4	4			5						
LECTURE 6-7. Regularities of traits inheritance	6,7	13	4	4			5						
Total for content module 1	7	48	14	14			20						
Content Module 2.													
LECTURE 8-9. Variability in genetics	8,9	18	4	4			10						
LECTURE 10. Genetics of Populations	10	14	2	2			10						
Total for content module 2	10	32	6	6			20						
Content Module 3.													
LECTURE 11-12. Inbreeding and heterosis in plant breeding	11, 12	13	4	4			5						
LECTURE 13. Polyploidy and remote hybridization	13	9	2	2			5						
LECTURE 14. Genetics plant immunity	14	9	2	2			5						
LECTURE 1. Genetic engineering	15	9	2	2			5						
Total for content module 3	15	40	10	10			20						
Course project (work) on _____ (if included in the curriculum)			-	-	-		-	-	-	-			
Total hours		120	30	30			60						

4. Seminar topics

№	Topic title	Number of hours
1	not provided	

5. Practical class topics

№	Topic title	Number of hours
1	Morphological identification of chromosomes. The study of karyotypes of rural and urban plants. cultures	2
2	Nucleic acid structure, DNA replication	2
3	Mechanisms of implementation of genetic information	2
4	Mechanisms of regulation of gene activity	2
5	Solving problems in molecular genetics	2
6	Distribution of nuclear hereditary information in the cell. Mitosis.	2
7	The main regularities of the distribution of genetic material during meiosis	2
8	Inheritance of traits in mono- and dihybrid crossing	2
9	Inheritance of traits in the interaction of non-allelic genes. Complementary interaction of genes	2
10	Inheritance of traits in the interaction of non-allelic genes. Epistatic interaction of genes (epistasis)	2
11	Inheritance of traits in the polymeric type of gene interaction	2
12	Linked inheritance of genes	4
13	Genetic structure of populations	2
14	Male sterility and its use in heterosis plant selection.	2
15	Morphological identification of chromosomes. The study of karyotypes of rural and urban plants. cultures	

6. Laboratory class topics

№	Topic title	Number of hours
1	not provided	

7. Independent work topics

№	Topic title	Number of hours
1	Genetics, the history of its development and its place in the system of natural sciences.	2
2	Cell organelles and their importance in heredity.	2
3	Morphological and molecular structure of chromosomes.	2
4	Concept of karyotype. Chromosome numbers of plants.	2
5	Mitosis, endomitosis, polythenia.	2
6	Meiosis.	4
7	Micro- and macrogametogenesis in flowering plants.	2
8	DNA carrier of hereditary information (direct and indirect evidence). The structure of DNA and its replication.	2

9	Structure and functions of RNA.	2
10	Genetic code of heredity. Explain the essence of the universality of the code and the meaning of stop codons.	2
11	Protein synthesis in the cell. Relationship of DNA with messenger, transport and ribosomal RNA.	2
12	Modern ideas about the structure of a gene: promoter, operator, content part, terminator.	2
13	The structure of prokaryotic and eukaryotic genes. What is exon, intron. Alternative splicing.	2
14	Laws of inheritance. Laws of uniformity of hybrids of the first generation, splitting of hybrids of the second generation.	2
15	Polyhybrid crossing. The law of independent inheritance of traits. Determine the formulas of cleavage by genotype and phenotype.	2
16	Reversible crosses. Use of analyzing crosses in genetic analysis.	2
17	Inheritance of traits in the interaction of non-allelic genes. Complementarity, epistasis. Inheritance of traits during polymerization.	2
18	Chromosomal theory of heredity.	2
19	Inheritance of traits controlled by linked genes.	2
20	Cytoplasmic heredity, its molecular bases, features.	2
21	Modification variability.	2
22	Mutations, classify mutations according to their different types.	2
23	Physical mutagens and their effect on living organisms.	2
24	Chemical mutagens and their effect on living organisms.	2
25	Polyploids, their classification and genetic features.	4
26	Inbreeding and heterosis, their genetic essence, features.	2
27	Ontogeny, its main stages.	2
28	Genetics of populations. Hardy-Weinberg law.	2
29	Genetics of resistance against pathogens and pests.	2
30	Genetics, the history of its development and its place in the system of natural sciences.	2

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

Modul I

Variant I

Task 1. Please describe DNA, its structure and functions? What is the significance of DNA for living organisms?	
1. Task 2. One of the DNA strands included in the gene has the following nucleotide composition: TTTCTAACGGCTAAATTCGA... What amino acid sequence is encoded in this chain? How many changes will occur in the polypeptide chain (order or type of amino acids) if radiation knocked out the fourth nucleotide in the gene?	
Question 1. Arrange in accordance with the nucleic acids of the terms:	Question 6. DNA replication is a process:
A. DNA	1. Formation of an identical DNA molecule
1. double-stranded spiral	2. Reading information from it
2. single-chain molecule	3. Correction of errors in the structure of DNA
3. contains a thymine nucleotide	4. Replacement of some nucleotides with others
B. RNA	5. Doubling of DNA strands
4. spiral chains are antiparallel	
5. There are several types	
6. is in the nucleus	
Question 2. Which of the scientists and when experimentally confirmed the semi-conservative mechanism of DNA replication?	Question 7. Replication of DNA are:
1. 1943, J. Watson and F. Crick	1. occurs simultaneously and continuously on both chains
2. 1953, Rosalind Franklin	2. on the leading one - continuously, on the lagging one - in fragments.
3. 1958, Meselson, Stahl	3. fragmentary on both chains
4. 1953, J. Watson and F. Crick	
5. 1973, G. Meller, F. Crick	
Question 3. Select all types of RNA that are in the cell:	Question 8. Arrange sequentially the processes of transfer of genetic information to eukaryotes:
1. Transport	1. Splicing
2. Nuclear	2. Intron cutting
3. Ribosomal	3. Transcription on mRNA
4. Basic	4. Translation in the formation of the ribosomal complex
5. Information	5. Amino acid transport
Question 4. The diploid organism has:	Question 9. Select all the basic properties of the genetic code:
1. Cells with half a set of chromosomes	1. Triplet
2. Cells with a double set of chromosomes	2. Overlap
3. Cells with a triple set of chromosomes	3. Unambiguous
Question 5. Is DNA polymerase able to start the replication process on its own?	4. Non-overlapping
1. Yes	5. Universal
2. No	Question 10. Genetic code is a way to record information about the structure of... (insert word)

9. Teaching methods.

The study of the discipline involves the complex use of various methods of organization and implementation of educational and cognitive activities of students and methods of stimulating and motivating their learning, which contributes to the development of the creative foundations of the personality of the future specialist, taking into account the individual characteristics of the participants in the educational process and communication.

To form professional competencies, innovative teaching methods are widely implemented, which provide a comprehensive update of the traditional pedagogical process, namely, computer support of the educational process, the introduction of interactive teaching methods (elaboration of discussion questions, etc.).

10. Forms of assessment

Writing tests, oral interviews, conducting discussions, listening to reports, analyzing independent work.

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 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

Electronic training course «Genetics». Zaika Ye.V., Shpakovich I.V.

<https://elearn.nubip.edu.ua/course/view.php?id=4045>

13. Recommended sources of information

1. Brooker R. Genetics. Analysis and Principles. Second Edition. – McGraw-Hill, 2005. – 842.
2. Anthony J.F. Griffiths, Susan R. Wessler, Richard C. Lewontin, Sean B. Carroll: Introduction to Genetic Analysis (Introduction to Genetic Analysis Ninth (9th) Edition, 2007. – 800 p.
3. Michael Goldberg, Janice Fischer, Leroy Hood, Leland Hartwell, Charles (Chip) Aquadro, Lee Silver and Ann E. Reynolds Genetics: From Genes to Genomes, 7th Edition, 2021.
4. Acquah, George. Principles of plant genetics and breeding / George Acquah. — 2nd ed., 2012, 732 p.