

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

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

APPROVED  
Faculty of Agrobiology  
“10” June 2025

**CURRICULUM OF ACADEMIC DISCIPLINE**

**Genetics**

Area of knowledge 20 Agricultural sciences and food supply

Specialty 201 Agronomy

Academic programme Agronomy

Faculty Agrobiological

Developed by: Zaika Ye.V., PhD, senior lecturer; Havriliuk I.V., assistant

Kyiv – 2025

**Description of the discipline.** Genetics is a fundamental biological discipline that studies heredity and variation in living organisms. The course covers classical Mendelian genetics, molecular genetics, cytogenetics, population genetics, and genomics. Students will learn about the structure and function of DNA, gene expression, inheritance patterns, mutations, and the application of genetic principles in medicine, agriculture, and biotechnology. The curriculum combines theoretical knowledge with laboratory practice, preparing students for careers in research, healthcare, biotechnology, and related fields.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	Bachelor's	
Specialty	201 Agronomy	
Academic programme	Agronomy	
Characteristics of the discipline		
Type	compulsory	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	3	
Course project (work) (if any)	exam	
Form of assessment	exam / credit	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	Part-time
Year of study	2	
Term		
Lectures	2	2
Practical classes and seminars	1	3
Laboratory classes	30 hr.	6 hr.
Self-study	30 hr.	4 hr.
Number of hours per week for full-time students	-	-

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

Aim the formation of students' deep understanding 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.

#### Competences acquired:

**Integral competence (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 competence (GC):

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

**GC 7.** Ability to apply knowledge in practical situations.

**GC 8.** Skills of performing safe activities.

Special (professional) competence (SC):

**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.

**Expected learning outcomes (ELO):**

ELO3. Discuss and explain the foundations that contribute to the development of general political culture and activity, the formation of national dignity and patriotism, socialization of the individual, a tendency to ethical values, knowledge of economics and law.

ELO7. Demonstrate knowledge and understanding of the principles of physiological processes of plants to the extent necessary for mastering fundamental and professional disciplines.

ELO8. Possess statistical methods of data processing in agronomy.

ELO9. Possess at the operational level methods of observation, description, identification, classification, as well as cultivation of objects and maintaining the stability of agrocenoses while preserving natural diversity

ELO10. Initiate prompt and expedient solutions to production problems in accordance with zonal conditions.

ELO16. Organize effective and safe working conditions.

**2. Programme and structure of the discipline**

Modules and topics	Number of hours												
	full-time							part-time					
	weeks	total	including					total	including				
			l	p	lab	ind.	s.st.		l	p	lab	ind.	s.st.
Module 1. <i>Fundamentals of trait inheritance</i>													
LECTURE 1. History of genetics. Mendel's Laws	1	13	2	2			5						
LECTURE 2 - 3. Cytological basis of heredity	2,3	13	4	4			5						
LECTURE 4-5.	4,5	13	4	4			5						
The chromosomal theory of heredity. Crossingover. Genetics of sex	6,7	13	4	4			5						
Total for module 1	7	48	14	14			20						
Module 2 <i>Molecular basis of heredity and applied aspects of molecular genetics</i>													
LECTURE 8-9. Understanding of nucleic acids. Functions of NC. Replication of DNA	8,9	18	4	4			10						
LECTURE 10. Realization of genetic information. Genetic code. Transcription and translation.	10	14	2	2			10						
Total for module 2	10	32	6	6			20						
Module 3 <i>Organization of genetical information on different level</i>													
LECTURE 11-12. Realization of genetic information. Genetic code. Transcription and translation.	11, 12		13	4	4		5						
LECTURE 13. Regulation of gene activity	13		9	2	2		5						
LECTURE 14. Organization of genomes and technologies for their study	14		9	2	2		5						
LECTURE 15. Population genetics. Inbreeding and heterosis	15		9	2	2		5						
Total for content module 3	15		40	10	10		20						
Total hours			120	30	30		60						

### 3. Topics of lectures

№ з/П	Назва теми	Кількість годин
1	Structure of Nucleic Acids. DNA Molecule Replication	2
2	Mechanisms of Genetic Information Expression	2
3	Regulation of Gene Activity. Genetic Engineering	4
4	G. Mendel's Laws	2
5	Cytological Basis of Heredity. G. Mendel's Laws	4
6	Chromosome Theory of Heredity	2
7	Patterns of Trait Inheritance in Gene Interaction	2
8	Types of Variability	4
9	Population Genetics	2
10	Inbreeding, Heterosis, and Male Sterility	2
11	Patterns of Distant Hybridization	2
12	Genetics of Plant Immunity	2

### 4. Topic of laboratory (practical, seminars) classes

№	Topic title	Number of hours
1	Problems on mono- and hybrid crossing	2
2	Mitosis Meiosis	2
3	Complementary interaction of genes	2
4	Epistatic interaction of genes	2
5	Polymeric inheritance of traits	2
6	Linkage disequilibrium of genes	2
7	Karyotype	2
8	The structure of DNA. Replication	2
9	The genetic code. Point mutations (problem solving)	2
10	Realization of genetic information	2
11	Structure of the gene	2
12	Genetic engineering	2
13	Mutational variability. Polyploidy. Colchicine as a directed mutagen	2
14	Solving problems on population genetics	2
15	Schemes for obtaining hybrids based on CMS or another sterility systems	2
All		30

### 5. Topics for self-study

№	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.	2
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	2

	and ribosomal RNA.	
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.	2
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

## 6. Methods of assessing expected learning outcomes:

(select necessary or add)

- oral examination;
- defense of practical work;
- modular tests;
- exam.

### Teaching methods:

1. – problem-based learning method.
2. – practice-oriented learning method.
3. – research-based learning method.
4. – educational discussions and debates method.

## 8. 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"

### 8.1. Distribution of points by types of educational activities

Type of educational activity	Learning outcomes	Evaluation
Module 1. Molecular and cytological basis of heredity		
Practical work 1.	PRN 4, 9, 11, 14. Including be able apply genetic, genomic, hybridological, population, cytological analyses, to be oriented in different levels of analysis of hereditary information. To know the mechanisms of preservation, realization and transmission of	7
Practical work 2.		7
Practical work 3.		7
Practical work 4.		7
Practical work 5.		7

Practical work 6.	hereditary information, the process of realization of the genotype in ontogenesis and in environmental conditions; possibilities of genetic engineering.	<b>14</b>
Practical work 7.		<b>7</b>
Independent work 1.		<b>14</b>
Modular test 1		<b>30</b>
<b>Total by module 1</b>		<b>100</b>
<b>Module 2. Heredity and variability. Applied aspects of genetics</b>		
Practical work 8.	PRN 4, 9, 11, 14. To possess methods for assessing the process of genotype realization in ontogenesis and in environmental conditions; to determine modifying and mutagenic environmental factors; to understand genetic processes occurring in populations; predict the possible consequences of crossbreeding systems to achieve maximum reduction in research time.	<b>7</b>
Practical work 9.		<b>7</b>
Practical work 10.		<b>7</b>
Practical work 11		<b>7</b>
Practical work 12		<b>7</b>
Practical work 13		<b>7</b>
Practical work 14		<b>7</b>
Practical work 15		<b>7</b>
Independent work 2.		<b>14</b>
Modular test 2		<b>30</b>
<b>Total by module 2</b>		<b>100</b>
<b>Educational work</b>	<b>(M1 + M2)/2*0.7 ≤ 70</b>	
<b>Exam/test</b>	<b>30</b>	
<b>Total per course</b>	<b>(Coursework + exam) ≤ 100</b>	

### 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

<b><i>Deadlines and exam retaking rules</i></b>	Works submitted after the deadline without good reason are evaluated with a lower grade. Re-sitting of modules is carried out with the permission of the lecturer if there are good reasons (for example, illness).
<b><i>Academic integrity rules</i></b>	Policy on academic integrity Cheating during tests and exams is prohibited (including using mobile devices). Independent works, essays must have correct text references to the literature used
<b><i>Policy on attendance</i></b>	Attendance of classes is mandatory. For objective reasons (illness, international internship) training can be carried out individually (in online form in agreement with the dean of the faculty)

### 7. Teaching and learning aids:

- e-learning course of the discipline (<https://elearn.nubip.edu.ua/course/view.php?id=4045>).
- references to digital educational resources.
- textbooks, manuals, tutorials.
- guidelines for studying disciplines by full-time and part-time students.
- internship programmes of the discipline (if included in the curriculum).

## 8. Recommended sources of information

1. Genetics with the basics of breeding. Strelchuk S.I., Demidov S.V., Berdyshev G.D., Golda D.M. K. 2004. 289 p.
2. Genetics with the basics of plant breeding: a textbook. O. L. Sichnyak. Odesa. Odessa. National University named after I. I. Mechnikov, 2022. 192 p.
3. Pavlichenko V.I., Bulyk R.E., Kushniryk O.V. Fundamentals of molecular biology: a textbook. Ed. 2nd, supplemented. Chernivtsi, 2020. 507 p.
4. Collection of problems in genetics. Kostenko S.O., Suprun I.O. K. 2010. 140 p.
5. Genetics. Practical course. Sokolov I.D., Shelikhov P.V. K. 2003. 213p.
6. Totsky V.M. Genetics. Odesa. Astroprint. 2008. 710 p.
7. Genetics A.V. Syvolob, S.R. Rushkovsky, S.S. Kyryachenko and others; ed. A.V. Syvolob. K.: Publishing and Printing Center "Kyiv University", 2008. 320 p.

### Information Resources

1. [www.biosciens.ws](http://www.biosciens.ws)
2. [www.biology.org.ua](http://www.biology.org.ua)
3. [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)
4. Recombination (Animation, English) <http://web.mit.edu/engelward-lab/animations.htm>
5. DNA Replication (animation, English)  
[http://www.wiley.com/college/pratt/0471393878/student/animations/dna\\_replication/index.html](http://www.wiley.com/college/pratt/0471393878/student/animations/dna_replication/index.html)

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## APPROVED

by the Dean of the Agrobiological  
Faculty  
\_\_\_\_\_ Vitalii KOVALENKO  
10.06.2025

## APPROVED

at the meeting of the Department department of Genetics,  
Breeding and Seed Rising named after Professor Zelensky  
M.O  
Minutes No.13 of 29.05.2025  
Head of the Department\_\_\_\_\_ Oleksandr MAKARCHUK

## REVIEWED

Guarantor of the AP EP «Agronomy»  
\_\_\_\_\_ Volodymyr MOKRIYENKO

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### Genetics

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