NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

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

"APPROVED"
Dean of the Agrobiological Faculty
Vitalii KOVALENKO
"23" 05 2024

"APPROVED"
at the meeting of the department of Genetics, Breeding and Seed Rising named after Professor Zelensky M.O
Protocol № 10 dated "16" 05. 2024 p.
Head of Department Olexandr MAKARCHUK

"REVIEWED"
Program Coordinator EP «Agronomy»
Vitalii KOVALENKO

CURRICULUM OF ACADEMIC DISCIPLINE

Genetics

Field of knowledge 20 Agricultural sciences and food supply
Specialty 201 Agronomy
Academic programme Agronomy
Faculty (Education and Research Institute) Agrobiological
Author(s): Zaika Ye.V., PhD, senior lecturer, Shpakovich I.V., assistant

Kyiv – 2024

Description of the discipline Genetics

Academic degree, specialty, academic programme		
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)	-	
Form of assessment	*exam*	
Indicators of the discipline for full-time and part-time forms of university study		
	Full-time	Part-time
Year of study	*2*	*2*
Semester	*1*	*3*
Lectures	*30 hr.*	*6 hr.*
Practical classes and seminars	*30 hr.*	*4 hr.*
Laboratory classes	-	-
Self-study	*60 hr.*	-
Number of hours per week for full-time students	*4*	-

1. Aim, objectives, 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.

Acquisition of competences:

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 competences (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)

2. Programme and structure of the discipline for:

- full-time (part-time) form of study.

Names of content 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.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Module 1. **Fundamentals of trait inheritance**													
LECTURE 1. History of genetics. Mendel's Laws	1	13	2	2			5						
LECTURE 2 - 3. Cytological basis of	2,3	13	4	4			5						

heredity													
LECTURE 4-5. The chromosomal theory of heredity. Crossingover. Genetics of sex	4,5	13	4	4			5						
LECTURE 6-7. Practical usage of Mendelian genetics in crop breeding. Types of variability	6,7	13	4	4			5						
Total for content module 1	7	48	14	14			20						
Module 2. **Molecular basis of heredity and applied aspects of molecular genetics**													
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 content module 2	10	32	6	6			20						
Module 3. **Organization of genetical information on different level**													
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 practical 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

4. 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 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	2

	generation, splitting of hybrids of the second generation.	
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

5. Tools for assessing expected learning outcomes:

- exam.
- module tests.
- other types.

6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration, demonstration);
- processing learning resources (note-taking,summarising, reviewing, writing an abstract);
- video method (remote, multimedia, web-based, etc.);
- self-study (completing assignments);
- individual research work/

7. Assessment methods:

- exam;
- oral or written assessment;
- module tests;
- essays and reports;
- presentation of laboratory and practical works;

8. Distribution of points received by students

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*.

Student's rating, points	National grading of exams and credits	
	exams	credits
90-100	excellent	pass
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	fail

To determine a student's rating in the discipline $\mathbf{R_{DIS}}$ (up to 100 points), the received assessment rating $\mathbf{R_A}$ (up to 30 points) is added to the academic performance raiting $\mathbf{R_{AP}}$ (up to 70 points): $\mathbf{R_{DIS}} = \mathbf{R_{AP}} + \mathbf{R_A}$.

9. Teaching and learning aids

- Electronic training course «Genetics». Zaika Ye.V., Shpakovich I.V. https://elearn.nubip.edu.ua/course/view.php?id=4045;
- lectures and presentations (in electronic form);
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students;

10. Recommended sources of information

1. Brooker R. Genetics. Analisys 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. Acquaah, George.Principles of plant genetics and breeding / George Acquaah. — 2nd ed., 2012, 732 p.