NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Physics DEPARTMENT

APPROVED
Faculty (Institute)_____ Plant Protection, Biotechnology and Ecology
(назва)
"_5_" 06 2025

PROGRAM OF THE COURSE

BIOPHYSICS AND MATHEMATICS: BIOPHYSICS

Specialization _____H1 Agronomy (**Plant protection and quarantine)**

Educational program _____ Plant protection and quarantine

_____
Faculty (Institute)_____ Plant Protection, Biotechnology and Ecology
Developers: candidate of physical and mathematical sciences, associate professor Oksana Godlevska

Kyiv – 2025

1.Description of the course “BIOPHYSICS”

Field of knowledge, specialization, educational program, educational degree		
Educational degree	*Bachelor's*	
Specialization	«Plant protection and quarantine»	
Educational program	H1 Agronomy	
Characteristics of the course		
Type	Compulsory	
Total number of hours	72	
Number of ECTS credits	3	
Number of content modules	2	
Course project (work) (if applicable)	-	
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)	1	1
Semester	2	2
Lecture classes	15 hr.	30hr.
Practical, seminar classes	30 hr.	30hr.
Laboratory classes	-	-
Self-study	27 hr.	60hr.
Individual assignments	- hr.	-hr.
Number of weekly classroom hours for the full-time form of study	3hr.	-

2.**Purpose, objectives, and competencies of the course**

The main objective of the course " Biophysics" is to expose principal laws and theses of physics which make it possible to study general regularities of natural phenomena; to apply the principles and methods of the physical sciences to biological problems; to consider the biophysical problems which are concerned with the viability of agricultural animals and their interaction with the environment; to elucidate possible application of physical instrumentation to plant protection.

The main requirements to the student after studying by him the course "Biophysics" are the following:

The student must know

the main physical quantities and units, principal laws and theses of general physics, theory and practice of measurement errors;
general physical processes and phenomena which take place in the living organism;
the effects of external physical factors on agricultural plant and their interaction with the environment;
possibility of the application of physical instrumentation to plant protection.

The student must be able

to process experimental data and estimate measurement errors;
to explain physical principles and mechanisms of function of living organism;
to use modern physical methods and devices in plant protection practice.

Final control is carried out in the form of tests for each of the modules and an exam.

Acquisition of competencies

The study of the academic discipline "Biophysics" contributes to the fact that, according to this standard, the student is able to acquire:

Integral competencies (IC):

Possess knowledge of the fundamental sections of higher mathematics, biophysics, chemistry (analytical, organic, inorganic, physical and colloidal), botany and agrozoology to the extent necessary for understanding the processes of the specialty plant protection and quarantine.

general competencies (GC):

GC1. Ability to abstract thinking, analysis and synthesis.

GC2. Ability to apply knowledge in practical situations.

GC3. Knowledge and understanding of the subject area and understanding of professional activity.

GC7. Ability to learn and master modern knowledge and search, processing and analysis of information from various sources.

Program learning outcomes (PLO):

PLO4. Possess knowledge of the fundamental sections of higher mathematics, biophysics, chemistry (analytical, organic, inorganic, physical and colloidal), botany and agrozoology to the extent necessary for understanding the processes of the specialty plant protection and quarantine.

3. The program and structure of the educational discipline for:

-full-time education.

Names of content modules and topics	Number of hours												
	Full-time form							Part-time form					
	weeks	total	including					total	including				
			l	p	lab	indi-vidu-al	self		l	p	lab	individual	self
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Content module 1. Mechanics. Acoustics. Thermodynamics.													
Topic 1. Mechanics. Kinematics, dynamics, statics. Elastic properties of bodies.	1-2	7	1	4			2						
Topic 2. Biomechanics	2-3	5	1	2			2						
Topic 3. Hydrodynamics.	3-4	7	1	2			4						
Topic 4. Molecular physics. Temperature and humidity of the environment	4-5	7	3	2			2						
Topic 5. Acoustics, bioacoustics.	5-7	7	1	4			2						
Topic 6. Thermodynamics of equilibrium and irreversible states and processes.	7-8	5	1	2			2						

Together according to content module 1	38		8	16			14						
Content module 2. Electricity. Magnetism. Optics.													
Topic 1. Electricity, bioelectricity.	9-10	10	2	4			4						
Topic 2. Magnetism, biomagnetism.	11-12	9	2	4			3						
Topic 3. Geometric, wave optics.	13-14	10	2	4			4						
Topic 4. Physiological optics and photobiology	15	5	1	2			2						
Together according to content module 2	34		7	14			13						
Total hours	**72**		**15**	**30**			**27**						
Course project (work) with_____			-	-	-		-		-	-	-		-
Total hours													

4.Seminar topics

№	Topic title	Number of hours
1		

5. Laboratory class topics

№	Topic title	Number of hours
1		

6. Practical class topics

№	Topic title	Number of

		hours
1.	Statistical calculations (error, significant figure, rounding).	2
2.	Lab. work 1-1. Determining the acceleration of free fall using a mathematical pendulum	2
3.	Lab. work 1-2. Determination of Young's modulus of elastic substances	2
4.	Lab. work 1-3. Determination of the moment of inertia of a torsional pendulum.	2
5.	Lab. work 2-1. Determination of the rate of sedimentation of bodies and the coefficient of internal friction of a liquid by the Stokes method	2
6.	Lab. work 2-2. Determination of the ratio of specific heat capacities C_p/C_V of gas by the method of adiabatic expansion (Clément-Desormes method).	2
7.	Lab. work 2-3. Determination of the surface tension of a liquid by the droplet separation method.	2
8.	Lab. work 2-4. Determination of entropy change during melting of tin.	2
9.	Lab. work 3-1. Study of the electrostatic field	2
10.	Lab. work 3-2. Determination of the electromotive force of the current source by the compensation method	2
11	Lab. work 4-1. Determination of the specific charge of an electron using the magnetron method.	2
12.	Lab. work 4-2. Determination of the horizontal induction component of the Earth's magnetic field.	2
13.	Lab. work 5-1. Determination of refractive indices using a microscope	2

14.	Lab. work 5-6. Determination of the wavelength of light using a diffraction grating	2
15.	5-8. Determination of Planck's constant by the Lukyrskyi method.	2

7. Self-study

№	Topic title	Number of hours
1	Processing of lecture material	10
2	Preparation for laboratory classes	12
3	Preparation for control works (testing)	5

8.Teaching methods.

The following teaching methods are used when teaching the discipline:

1. Lecture.

2. Laboratory work - to use acquired knowledge to solve practical problems.
The knowledge of a higher education applicant is assessed on a 100-point scale and is converted into a national assessment in accordance with the current "Regulations on Examinations and Tests at the NULES of Ukraine"

8.1 Distribution of points by types of educational activities

Type of educational activity	Learning outcomes	Evaluation
Module 1. Mechanics. Acoustics. Thermodynamics.		
Statistical calculations (error, significant figure, rounding).	Report	**10**
Determining the acceleration of free fall using a mathematical pendulum	Report	**10**
Determination of Young's modulus of elastic substances	Report	**10**
Test task	Answers to questions	**10**
Determination of the ratio of specific heat capacities C_p/C_V of gas by the method of adiabatic expansion (Clément-Desormes method).	Report	**10**
Determination of the surface tension of a liquid by the droplet separation method.	Report	**10**
Determination of entropy change during melting of tin.	Report	**10**
Determination of the wavelength of light using a diffraction grating	Report	**10**
Modular test 1	Answers to questions	**20**
Total by module 1		**100**
Module 2. Electricity. Magnetism. Optics.		

Study of the electrostatic field	Report	**10**
Determination of the electromotive force of the current source by the compensation method	Report	**10**
Determination of the specific charge of an electron using the magnetron method.	Report	**10**
Determination of the horizontal induction component of the Earth's magnetic field.	Report	**10**
Determination of refractive indices using a microscope	Report	**10**
Determination of the wavelength of light using a diffraction grating	Report	**10**
Determination of Planck's constant by the Lukyrskyi method.	Report	**10**
Modular test 2	Answers to questions	**30**
Total by module 2		**100**
Educational work		**(M1 + M2)/2*0,7 ≤ 70**
Exam		**30**
Total per course		**(Educational work + Exam) ≤ 100**

9. Forms of control

When teaching the discipline, the following forms of control are provided during the semester for full-time students: oral survey and express testing in laboratory classes, defense of reports on individual laboratory tasks, modular control works, exam at the end of the 2st semester.

10.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"

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): $\mathbf{R_{dis} = R_{aw} + R_{ex}}$.

11. Educational and methodological support.

All methodological support - lecture material, description of laboratory works and tasks for independent work are available on electronic media and in electronic training courses: for the full term of training -https://elearn.nubip.edu.ua/course/view.php?id=2511. Students learn informational material that is sufficiently covered in educational literature on their own. There is a sufficient amount of recommended literature in the library of NULES of Ukraine.

12. Recommended sources of information

V. Boyko, , P. Ilyin, O. Godlevska. *Physics. Навчальний посібник для студентів, що слухають лекції англійською мовою.* Київ, Ліра-К, 2024-286с.

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. Бойко В.В., Відьмаченко А.П., Залоїло І.А., Малюта М.В. Фізика з основами кваліметрії: Навчальний посібник. - К.: Видавництво «Ліра– К», 2018, – 564 с.

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Бойко В.В., Відьмаченко А.П., Ільїн П.П., Гуменюк Я.О., Чорній В.П., Малюта М.В. Методичні вказівки до виконання лабораторних робіт з фізики. Частина 1. // К.:, Видавничий центр НУБіП України. 2017. -86 с.

Бойко В.В., Відьмаченко А.П., Ільїн П.П., Гуменюк Я.О., Чорній В.П., Малюта М.В. Методичні вказівки до виконання лабораторних робіт з фізики. Частина 2. // К.:, Видавничий центр НУБіП України. 2017. -72 с.

Бойко В.В., Відьмаченко А.П., Ільїн П.П., Гуменюк Я.О., Чорній В.П., Малюта М.В. Фізика. Методична розробка для підготовки до зовнішнього незалежного оцінювання (ЗНО); проведення занять зі слухачами відділень довузівської підготовки; самостійної роботи студентів технічних та технологічних спеціальностей вузів // Київ:, Видавництво «Профі», 2017. -410 с.

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2. Механіка. Основні поняття.
URL: https://www.youtube.com/watch?v=hyEul6F8baw

3. Молекулярна фізика. Початок термодинаміки.
URL: https://www.youtube.com/watch?v=fo2HE2tu_3I

4. Електростатика. Електроємність. Конденсатори.
URL: https://www.youtube.com/watch?v=37E2Gc73HaA

5. Магнетизм. Основи. Електрична і магнітна взаємодії. Індукція магнітного поля.
URL: https://www.youtube.com/watch?v=_jReBOzCFLI

6. Оптика. Основні положення.
URL: https://www.youtube.com/watch?v=v64Vq_k-yHo

7. Портал: Фізика – Вікіпедія
URL: https://uk.wikipedia.org/wiki/Портал:Фізика