NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Physics DEPARTMENT

APPROVED
Faculty (Institute)_____
Plant Protection,
Biotechnology and Ecology
(назва)
"_19_" 06 2026

PROGRAM OF THE COURSE

Fundamentals physics and biophysics

Specialization _____G21 "Biotechnologies and bioengineering"

Educational program _____ "Biotechnologies and bioengineering"

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

Kyiv – 2026

1.Description of the course “Fundamentals physics and biophysics”

Field of knowledge, specialization, educational program, educational degree		
Educational degree	*Bachelor's*	
Specialization	G21 "Biotechnologies and bioengineering"	
Educational program	Biotechnologies and bioengineering	
Characteristics of the course		
Type	Compulsory	
Total number of hours	90	
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	
Semester	1	
Lecture classes	15 hr.	
Practical, seminar classes	-	
Laboratory classes	30 hr.	
Self-study	45	
Individual assignments	-	
Number of weekly classroom hours for the full-time form of study	3hr.	

Purpose, objectives, and competencies of the course

The discipline " Fundamentals physics and biophysics " is one of the main parts of the theoretical training of bachelors in the specialty G21 "Biotechnologies and bioengineering", that is, the basis without which a full study of the disciplines of the cycle of professional and practical training of such specialists is impossible.

The Purpose of studying the discipline is the consistent study by students of the basic laws and provisions of physics in order to understand the general regularities of natural phenomena; the use of these laws in the prompt resolution of problems; illumination of possible applications of physical methods and devices in practical activities.

The tasks of the academic discipline are as follows:

Providing students with sufficiently broad training in the field of physics, mastery of fundamental concepts and theories of classical and modern physics, which provides them with effective mastery of special subjects and the further possibility of using physical principles. This also includes teaching students methods and skills for solving specific problems and familiarizing them with measuring equipment.

Formation of students' scientific outlook and modern physical thinking. This task should also be considered as an essential part of the humanitarian training of the future specialist, since most issues of the history of science and philosophy can be demonstrated during the teaching of a physics course. As a result of studying the academic discipline "Fundamentals physics and biophysics ", the student should

know:

basic physical quantities, units of their measurements, basics of error theory and rules for processing measurement results, modern means of measuring physical quantities

- fundamental concepts and theories of classical and modern physics in order to effectively master special educational disciplines and use knowledge of physical laws in future work;

- methods of solving practical physical problems and problems;

- principles of operation of devices;

be able to: - use measuring tools, perform mathematical and statistical processing of measurement results;

- using physical conditions, laws and theories, apply the acquired theoretical and practical knowledge after studying special disciplines in the future work in the specialty;

- explain physical processes and phenomena that occur in the natural environment, as well as during the operation of various types of equipment.

Acquisition of competencies

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

Integral competence (IC):

The ability to solve complex specialized tasks and practical problems characterized by complexity and uncertainty in biotechnology and bioengineering, or in the process of learning that involves the application of the theory and methods of biotechnology and bioengineering.

general competencies:

GC8 Ability to conduct research at the appropriate level.

GK10 Ability to evaluate and ensure the quality of performed works.

professional (special) competences:

SC2. Ability to critically understand basic theories, methods and principles of natural sciences

Program learning outcomes (PLO):

PLO3. Understand the main concepts, theoretical and practical problems in the field of natural sciences, which are necessary for analysis and decision-making in the field of ecology, environmental protection and balanced nature management

PLO21. Be able to choose optimal methods and tools for research, data collection and processing.

The structure of the scientific discipline

Names of content modules and topics	Number of hours											
	full-time form						Part-time form					
	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
Content module 1. Mechanics. Molecular physics.Thermodynamics.												
Topic 1.1. Kinematics and dynamics of a material point. Kinematic and dynamic characteristics of biological objects.	6	2		2		4						
Topic 1.2. Work and energy. Energy and metabolism. Elastic properties of biological materials	8	2		4		5						
Topic 1.3. Fundamentals of hydrodynamics and hydrostatics.	10	2		4		5						
Topic 1.4. Fundamentals of molecular kinetic theory and thermodynamics. The influence of thermal factors on plants and animals.	10	2		6		7						
Module 2. Electrostatics and direct electric current. Magnetism. Oscillations and waves. Physics of the atom and atomic nucleus.												

Topic 2.1. Electrostatics and direct electric current. Natural electric fields. The influence of electric fields on living organisms	6	2		2		5						
Topic 2.2. Magnetic field. The phenomenon of electromagnetic induction. The influence of magnetic fields on living organisms	8	2		4		6						
Topic 2.3. Harmonic oscillations. Waves.	8	2		4		7						
Topic 2.4. Physics of the atom and atomic nucleus.	6	1		4		6						
Total hours	**90**	**15**		**30**		**45**						

Laboratory 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 1-3. Determination of the moment of inertia of a torsional pendulum.	
4.	Lab. work 1-4. Determination of Young's modulus of elastic substances	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 2-3. Determination of the surface tension of a liquid by the droplet separation method.	

7.	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
8.	Control from module 1	2
9.	Lab. work 3-1. Study of the electrostatic field	2
10.	Lab. work 4-1. Determination of the specific charge of an electron using the magnetron method.	2
11	Lab. work 4-2. Determination of the horizontal induction component of the Earth's magnetic field.	2
12.	Lab. work 5-1. Determination of refractive indices using a microscope	2
13.	Lab. work 5-7. “Test of Malus's law”	2
14.	Lab. work 5-6. Determination of the wavelength of light using a diffraction grating	2
15.	Control from module 2	2

Self-study

№	Topic title	Number of hours
1	Processing of lecture material	15
2	Preparation for laboratory classes	15
3	Preparation for control works (testing)	15

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.

Assessment of learning outcomes.

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"

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	Report	**10**

induction component of the Earth's magnetic field.		
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**

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 1st semester.

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

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=3659

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.

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.

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

7. Портал: Фізика – Вікіпедія
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