Ministry of Education and Science of Ukraine
Dnipro University of Technology

Department of Physics

«APPROVED»
Head of Department
Horiev Viacheslav _____
«31» August 2023 year

WORK PROGRAM OF THE ACADEMIC DISCIPLINE
«General Physics»

Field of study ……..…	14 Electrical engineering
Specialty ……...	141 Electrical energetics, electrical engineering and electromechanics
Academic degree ……	Bachelor
Academic program …….	Power engineering, electrical engineering and electromechanics
Type of discipline ……	normative
Total workload ..…… …	9 credits (270 hours)
Type of final assessment ……..	exam
Period of study ……..……	1st & 2nd semester
Language of study ……..	English

Lecturer: Voronko T.Y.

Prolonged: for 20__/20__ academic year _____(_____) «__»___ 20__.
(Signature, name, date)

for 20__/20__ academic year _____(_____) «__»___ 20__.
(Signature, name, date)

Dnipro
NTU "DP"
2023

Work program of the academic discipline “General Physics” for bachelor’s specialty 141 «Electrical energetics, electrical engineering and electromechanics» / Dnipro University of Technology. Department of Physics. – D.: NTU «DP», 2023. – 13 p.

Author:
- Voronko Tetiana Yevhenivna – Associate Professor of the Department of Physics;
- Zhuravlov Mykhailo Oleksandrovych – Senior Lecturer of the Department of Physics.

The work program regulates:

– key goals and objectives;
– the disciplinary learning outcomes generated through the transformation of the intended learning outcomes of the degree program;
– the content of the discipline formed according to the criterion “disciplinary learning outcomes”;
– the discipline program (thematic plan by different types of classes);
– distribution of the discipline workload by different types of classes;
– an algorithm for assessing the level of achievement of disciplinary learning outcomes (scales, tools, procedures and evaluation criteria);
– criteria and procedures for evaluating the academic achievements of applicants by discipline;
– the contents of the educational and methodological support of the discipline;

The work program is designed to implement a competency approach in planning an education process, delivery of the academic discipline, preparing students for control activities, controlling the implementation of educational activities, internal and external quality assurance in higher education, accreditation of degree programs within the specialty.

Approved by the decision of the Methodical Commission of specialty 141 «Electrical energetics, electrical engineering and electromechanics» (protocol №21/23-07 14.07.2023).

CONTENT

1 DISCIPLINE OBJECTIVES

In the educational and professional programs of the Dnipro University of Technology 141 «Electrical energetics, electrical engineering and electromechanics» the distribution of program learning outcomes (PLO) for the organizational forms of the educational process is done. In particular, the following learning outcomes are attributed to the discipline B2 "General physics":

PLO07	To carry out analysis of processes in electrical, electrical and electromechanical equipment, relevant complexes and systems.
PLO08	To Select and apply suitable methods for analysis and synthesis of electromechanical and electrical systems with specified parameters.

The objective of discipline – formation acquirers of competencies, skills and knowledge in the field of physics regarding fundamental concepts, laws and theories of classical and modern physics, which provides them with effective mastery of special disciplines and the further possibility of using physical principles in the field of electrical engineering.

The implementation of the objective requires transforming program learning outcomes into the disciplinary ones as well as an adequate selection of the contents of the discipline according to this criterion.

2 INTENDED DISCIPLINARY LEARNING OUTCOMES

Code PLO	**Disciplinary learning outcomes (DRN)**	
	DLO code	**content**
PLO07	PLO07.1-B2	analyze the results of observations and experiments using the basic laws of physics, use physical devices
	PLO07.2-B2	to analyze physical mechanisms that are essential when considering processes in electric power, electrotechnical and electromechanical equipment, relevant complexes and systems
	PLO07.3-B2	formation of abilities to generalize, analyze, perceive information, set a scientific problem and choose a way to solve it
PLO08	PLO08.1-B2	formulate physical ideas, solve problems, estimate quantities, operate physical models and be aware of the limits of their applications
	PLO08.2-B2	apply knowledge of the basic fundamental laws of classical and modern physics to solve electrical engineering problems
	PLO08.3-B2	correctly reproduce physical ideas and correctly apply the principles and laws of physics for the analysis and synthesis of electromechanical and electric power systems with specified indicators

3 BASIC DISCIPLINES

The discipline is taught in the first and second semesters in accordance with the curriculum, so no additional requirements for basic disciplines are established. Interdisciplinary connections: the study of the course is based on knowledge obtained from previously studied disciplines in secondary education institutions.

To master the discipline "General Physics" within the scope of the given work program, the applicant must be able to perform arithmetic operations on numbers, convert powers and roots, and solve linear and quadratic algebraic equations. Have elementary knowledge of vectors, knowledge

of geometry and trigonometry within the school course. Have an idea of the basic concepts of differential and integral calculus.

4 WORKLOAD DISTRIBUTION BY THE FORM OF EDUCATIONAL PROCESS ORGANIZATION AND TYPES OF CLASSES

Type of classes	**Workload** hours	**Distribution by forms of education**, *hours*					
		Full-time		**Part-time**		**Distance**	
		Classes (C)	Individual work (IW)	Classes (C)	Individual work (IW)	Classes (C)	Individual work (IW)
lecture	174	67	107	-	-	14	131
practical	-	-	-	-	-	-	-
laboratory	96	37	59	-	-	12	113
tests	-	-	-	-	-	-	-
TOTAL	270	104	166	-	-	26	244

5 DISCIPLINE PROGRAM BY TYPES OF CLASSES

DLO code	**Types and topics of training sessions**	**The amount of the components (total / aud.),** *hours*
	LECTURES	**174**
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2 PLO08.2-B2 PLO08.3-B2	**1 Physical foundations of mechanics**	30
	1.1. Introduction to mechanics.	
	1.2. Elements of kinematics.	
	1.3. Dynamics of a material point and translational motion of a rigid body. Forces in mechanics.	
	1.4. Dynamics of a rigid body that has a fixed axis of rotation.	
	1.5. Conservation laws.	
	1.6. Elements of special relativity	
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2 PLO08.2-B2 PLO08.3-B2	**2 Electrodynamics**	56
	2.1. General information about the electrostatic field. Electrostatic field in vacuum.	
	2.2. Electrostatic field in matter.	
	2.3. Direct electric current.	
	2.4. Electric current in gases.	
	2.5. A constant magnetic field in a vacuum.	
	2.6. The effect of a magnetic field on moving charges and a current-carrying conductor.	
	2.7. Magnetic field in matter.	
	2.8. The phenomenon of electromagnetic induction.	
	2.9. Fundamentals of Maxwell's theory for the electromagnetic field	
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2	**3. Oscillatory and wave processes**	38
	3.1. General information about oscillating processes, free oscillations.	
	3.2. Addition of harmonic oscillations, forced oscillations.	

DLO code	Types and topics of training sessions	The amount of the components (total / aud.), *hours*
PLO08.2-B2 PLO08.3-B2	3.3. Wave processes, elastic waves.	
	3.4. Electromagnetic waves.	
	3.5. The concept of alternating current. Periodic processes in alternating current circuits.	
	3.6. General information about light waves. Interference of light. Diffraction of light. Polarization and dispersion of light.	
	3.7. Elements of quantum mechanics.	
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2 PLO08.2-B2 PLO08.3-B2	**4. Molecular physics and thermodynamics**	26
	4.1. Elements of classical and quantum statistics.	
	4.2. Fundamentals of thermodynamics.	
	4.3. Elements of physical kinetics. Transfer processes.	
	4.4. Aggregate states. Phase equilibrium and phase transformations.	
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2 PLO08.2-B2 PLO08.3-B2	**5. Elements of quantum theory of radiation, atomic physics and solid state physics**	12
	5.1. Fundamentals of quantum theory of thermal radiation.	
	5.2. Some quantum optical effects.	
	5.3. Physical foundations of quantum electronics. Spontaneous and forced radiation.	
	5.4. Elements of atomic physics.	
	5.5. Elements of band theory of solids and semiconductor physics.	
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2 PLO08.2-B2 PLO08.3-B2	**6. Physics of the atomic nucleus**	12
	6.1. Composition, binding energy of the nucleus and static characteristics of atomic nuclei.	
	6.2. Nuclear reactions. Radioactivity.	
	6.3. Elements of dosimetry and physical bases of nuclear energy.	
	6.4. Fundamental particles and interactions; modern physical picture of the world.	
	PRACTICAL TRAINING	**96**
PLO07.1-B2 PLO07.2-B2 PLO07.3-B2 PLO08.1-B2 PLO08.2-B2 PLO08.3-B2	1. Laboratory work on the physical foundations of mechanics	16
	2. Laboratory work on electrodynamics	36
	3. Laboratory work on oscillatory and wave processes	22
	4. Laboratory works on molecular physics and thermodynamics	12
	5. Laboratory work on elements of quantum theory of radiation, atomic physics and solid state physics	6
	6. Laboratory work on atomic nucleus physics	4
	TOTAL	**270**

6 KNOWLEDGE PROGRESS TESTING

Certification of student achievement is accomplished through transparent procedures based on objective criteria in accordance with the University Regulations “On Evaluation of Higher Education Applicants' Learning Outcomes”.

The level of competencies achieved in relation to the expectations, identified during the control activities, reflects the real result of the student's study of the discipline.

6.1 GRADING SCALES

Assessment of academic achievement of students of the Dnipro University of Technology is carried out based on a rating (100-point) and institutional grading scales. The latter is necessary (in the official absence of a national scale) to convert (transfer) grades for mobile students.

The scales of assessment of learning outcomes of the NTUDP students

Rating	Institutional
90…100	Excellent
74…89	Good
60…73	Satisfactory
0…59	Fail

Discipline credits are scored if the student has a final grade of at least 60 points. A lower grade is considered to be an academic debt that is subject to liquidation in accordance with the Regulations on the Organization of the Educational Process of NTUDP.

6.2 DIAGNOSTIC TOOLS AND EVALUATION PROCEDURES

The content of diagnostic tools is aimed at controlling the level of knowledge, skills, communication, autonomy, and responsibility of the student according to the requirements of the National Qualifications Framework (NQF) up to the 6th qualification level during the demonstration of the learning outcomes regulated by the work program.

During the control activities, the student should perform tasks focused solely on the demonstration of disciplinary learning outcomes (Section 2).

Diagnostic tools provided to students at the control activities in the form of tasks for the intermediate and final knowledge progress testing are formed by specifying the initial data and a way of demonstrating disciplinary learning outcomes.

Diagnostic tools (control tasks) for the intermediate and final knowledge progress testing are approved by the appropriate department.

Type of diagnostic tools and procedures for evaluating the intermediate and final knowledge progress testing are given below.

Diagnostic and assessment procedures

<table>
<tr><th colspan="3">INTERMEDIATE CONTROL</th><th colspan="2">FINAL ASSESSMENT</th></tr>
<tr><th>training sessions</th><th>diagnostic tools</th><th>procedures</th><th>diagnostic tools</th><th>procedures</th></tr>
<tr><td>lectures</td><td>control tasks for each topic</td><td>task during lectures</td><td rowspan="2">comprehensive reference work (CCW)</td><td rowspan="2">determining the average results of intermediate controls;

CCW performance during the examination at the request of the student</td></tr>
<tr><td>laboratory lessons</td><td>verification and protection</td><td>performance of laboratory work</td></tr>
</table>

During the intermediate control, the lectures are evaluated by determining the quality of the performance of the control specific tasks. Practical classes are assessed by the quality of the control or individual task.

If the content of a particular type of teaching activity is subordinated to several descriptors, then the integral value of the assessment may be determined by the weighting coefficients set by the lecturer.

Provided that the level of results of the intermediate controls of all types of training at least 60 points, the final control can be carried out without the student's immediate participation by determining the weighted average value of the obtained grades.

Regardless of the results of the intermediate control, every student during the final knowledge progress testing has the right to perform the CDF, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CDF should be consistent with the allotted time for completion. The number of CDF options should ensure that the task is individualized.

The value of the mark for the implementation of the CDF is determined by the average evaluation of the components (specific tasks) and is final.

The integral value of the CDF performance assessment can be determined by taking into account the weighting factors established by the department for each NLC descriptor.

6.3 EVALUATION CRITERIA

The actual student learning outcomes are identified and measured against what is expected during the control activities using criteria that describe the student's actions to demonstrate the achievement of the learning outcomes.

To evaluate the performance of the control tasks during the intermediate control of lectures and practicals the assimilation factor is used as a criterion, which automatically adapts the indicator to the rating scale:

$$O_i = 100\ a/m,$$

where a – number of correct answers or significant operations performed according to the solution standard; m – the total number of questions or substantial operations of the standard.

Individual tasks and complex control works are expertly evaluated using criteria that characterize the ratio of competency requirements and evaluation indicators to a rating scale.

The content of the criteria is based on the competencies identified by the NLC for the Bachelor's level of higher education (given below).

General criteria for achieving intended learning outcomes for the 6th qualification level of NQF (bachelor)

NQF descriptors	Requirements for knowledge, skills, communication, autonomy, and responsibility	Evaluation indicator
	Knowledge	
♦ conceptual scientific and practical knowledge, critical understanding of theories, principles, methods, and concepts in the field of professional activity and/or training	The answer is excellent – accurate, reasonable, sensible. One measures the presence of: – specialized conceptual knowledge at a high degree of state ownership issues; – critical understanding of problems in teaching and/or professional activities and on the verge of subject areas	95-100
	The answer contains non-gross mistakes or descriptions	90-94
	The answer is correct but has some inaccuracies	85-89
	The answer is correct but has some inaccuracies and insufficiently substantiated	80-84
	The answer is correct but has some inaccuracies, not reasonable and meaningful	74-79
	The answer is fragmentary	70-73
	The answer shows a fuzzy idea of a student regarding the subject	65-69
	Level of knowledge is minimally satisfactory	60-64
	Level of knowledge is unsatisfactory	<60
	Skills	
♦ in-depth cognitive and practical skills, mastery, and	The answer characterizes the ability to: - identify the problem; - formulate hypotheses;	95-100

NQF descriptors	Requirements for knowledge, skills, communication, autonomy, and responsibility	Evaluation indicator
innovativity at the level required to solve complex specialized tasks and practical problems in the field of professional activity or training	- solve problems; - update knowledge; - integrate knowledge; - to carry out the innovative activity; - - to carry out scientific activity	
	The answer characterizes the ability to apply knowledge in practice with minor mistakes	90-94
	The answer characterizes the ability to apply knowledge in practice but has some inaccuracies in the implementation of one requirement	85-89
	The answer characterizes the ability to apply knowledge in practice but has some inaccuracies in the implementation of two requirements	80-84
	The answer characterizes the ability to apply knowledge in practice but has some inaccuracies in the implementation of three requirements	74-79
	The answer characterizes the ability to apply knowledge in practice but has some inaccuracies in the implementation of four requirements	70-73
	The answer characterizes the ability to apply knowledge in practice while performing tasks on the sample	65-69
	The answer characterizes the ability to apply knowledge in performing tasks on the sample, but with inaccuracies	60-64
	Level of skills is unsatisfactory	<60
Communication		
♦ reporting to specialists and non-specialists information, ideas, problems, solutions, own experience, and argumentation; ♦ data collection, interpretation, and application; ♦ communication on professional issues, including in a foreign language, orally and in writing	Clarity of the answer (report). Language: - correct; - clean; - clear; - accurate; - logical; - expressive; - concise. Communication strategy: - coherent and consistent development of thought; - availability of own logical reasoning; - relevant arguments and its compliance with the provisions defended; - the correct structure of the answer (report); - correct answers to questions; - appropriate mastery to answer questions; - the ability to draw conclusions and formulate proposals; - use of foreign languages in professional activities	95-100
	Sufficient clarity of the answer (report) and appropriate communication strategy with minor flaws	90-94
	Good clarity of response (report) and appropriate communication strategy (three requirements not implemented in total)	85-89

NQF descriptors	Requirements for knowledge, skills, communication, autonomy, and responsibility	Evaluation indicator
	Good clarity of response (report) and appropriate communication strategy (four requirements not implemented in total)	80-84
	Good clarity of response (report) and appropriate communication strategy (five requirements not implemented in total)	74-79
	Satisfactory clarity of response (report) and appropriate communication strategy (a total of seven requirements not implemented)	70-73
	Satisfactory clarity of response (report) and appropriate communication strategy (a total of nine requirements not implemented)	65-69
	Satisfactory clarity of response (report) and appropriate communication strategy (a total of 10 requirements not implemented)	60-64
	The level of communication is unsatisfactory	<60
Autonomy and responsibility		
♦ management of complex technical or professional activities or projects; ♦ ability to carry responsibility for making and approving decisions in unpredictable work and/or learning contexts; ♦ forming judgments that consider social, scientific, and ethical aspects; ♦ organization and management of professional development of individuals and groups; ♦ the ability to continue study with a high degree of autonomy	Excellent individual ownership management competencies focused on: 1) management of complex projects, providing: - exploratory learning activities marked the ability to independently evaluate various life situations, events, facts, detect and defend a personal position; - the ability to work in a team; - control of their own actions; 2) responsibility for decision-making in unpredictable conditions, including: - justify their decisions the provisions of the regulatory framework of sectoral and national levels; - independence while performing tasks; - lead in discussing problems; - responsibility for the relationship; 3) responsible for the professional development of individuals and/or groups that includes: - use of vocational-oriented skills; - the use of evidence from independent and correct reasoning; - possession of all kinds of learning activities; 4) the ability to further study with a high degree of autonomy, which provides: - degree possession of fundamental knowledge; - independent evaluation judgments; - high level of formation of general educational skills; - search and analysis of information resources -	95-100
	Confident personality possession competency management (not implemented two requirements)	90-94
	Good knowledge management competencies personality	85-89

NQF descriptors	Requirements for knowledge, skills, communication, autonomy, and responsibility	Evaluation indicator
	(not implemented three requirements)	
	Good knowledge management competencies personality (not implemented the four requirements)	80-84
	Good knowledge management competencies personality (not implemented six requirements)	74-79
	Satisfactory ownership of individual competence management (not implemented seven requirements)	70-73
	Satisfactory ownership of individual competence management (not implemented eight claims)	65-69
	The level of autonomy and responsibility fragmented	60-64
	The level of autonomy and responsibility poor	<60

7 TOOLS, EQUIPMENT, AND SOFTWARE

Lecture demonstration experiments (about 150), physical laboratory practice (about 70 works), computer laboratory works, multimedia equipment, remote platform Moodle are used.

8 RECOMMENDED BIBLIOGRAPHY

Principal

1. Lecture notes for General Physics / Martin Kruczenski.-Department of Physics, Purdue University, 507p., 2016
2. College Physics for AP Courses /Irina Yablinska and other .- Texas Education Agency
3. Texas,USA , 850p., 2015
4. College Physics for AP Courses 2e / Irina Yablinska and other .- Texas Education Agency
5. Texas, USA , 890p., 2022
6. Bercley Physics Course. / .-- Libruary of Congress , USA, 954p., 2018
7. Universiny physics with modern physics/ Hugh D. Young, Hugh D.— San Francisco , USA, 1598 p., 2012
8. Physics / Paul Peter Uron and other.- Texas Education Agency, Texas,USA , 850p., 2020
9. University Physics Volume 1, 2, 3/ Samuel J. Ling fnd other .- Texas Education Agency
10. Texas,USA , 2390 p., 2016
11. English-Ukrainian Encyclopedic Dictionary of general definitions. Concepts and Laws from Physics / Іри-на Мороз. -Львів: Видавництво Львівської політехніки, 362с., 2020

Additional

1. Кучерук І.М., Горбачук І.Т., Луцік П.П. Загальний курс фізики, – Київ. Тех-ніка. – 1999 - 2004, т.1, 2, 3.
2. Курс фізики (під редакцією Лопатинського І.Є.). – Львів. – ”Бескід Біт”. – 2002.
3. Бушок Г.Ф., Левандовський В.В., Півень Г.Ф.. Курс фізики. У 2 кн.: Кн.1. Фізичні основи механіки. Електрика і магнетизм. – К.:«Либідь», 2001. – 448с. Бушок Г.Ф., Венгер Е.Ф.

Курс фізики. Кн.2. Оптика. Фізика атома і атомного ядра. Молекулярна фізика і термодинаміка. К. «Либідь»2001. – 422 с.

4. Курс загальної фізики. Навчальний посібник для вищих навчальних закладів. / КармазінВ.В., Семенець В.В.-К.: Кондор, 2016.-786 с
5. Бойко В.В., Булах В.І., Гуменюк Я.О., Ільїн П.П. Фізика. Підручник для вищих навчальних закладів. К.: Ліра-К, 2016. 468 с.
6. Фізика. Ч.1. Механіка. Молекулярна фізика та термодинаміка. Електрика.: Підручник для вищих навчальних закладів / В.В. Бойко, Г.О.Сукач, В.В. Кідалов. – К.: Видавництво ПРОФІ , 2016. – 371 с.
7. Фізика. Ч.2. Магнетизм. Оптика. Елементи квантової фізики, фізики твердого тіла, атома та ядра: Підручник для вищих навчальних закладів / В.В. Бойко, Г.О.Сукач, В.В. Кідалов. – К.: Видавництво ПРОФІ , 2016. – 319 с.
8. Лопатинський І.Є, Зачек І.Р., Юр'єв С.О. та ін. Збірник задач з фізики / Навч. посібник. – Львів: Вид-во Львівської політехніки, 2016. – 244 с.
9. Янг Г., Фрідман Р. Фізика для університетів. Львів, Наутілус. 2018. 1516 с.
10. Електрика та магнетизм : підручник / Л. Д. Дідух. — Тернопіль : Підручники і посібники, 2020. — 464 с.
11. Фізика. Механіка, молекулярна фізика та термодинаміка : навчальний посібник / Ю. О. Шкурдода, О. О. Пасько, О. А. Коваленко. – Суми : Сумський державний університет, 2021. –221 с.
12. Гаркуша І.П., Горбачук І.Т., Курінний В.П. та ін. Загальний курс фізики: Збірник задач – К.: «Техніка», 2004,– 560 с.
13. Гаркуша І.П., Курінний В.П. Фізика. Навчальний посібник у 7 частинах. Д.: Дніпровська політехніка, 2015-2018, 580 с. (Ч. 1. Механіка. Ч.2. Молекулярна фізика і термодинаміка. Ч.3. Електрика і магнетизм. Ч.4. Коливання і хвилі. Ч.5. Хвильова оптика. Ч.6. Квантова фізика. Ч.7. Фізика атомного ядра і елементарних частинок.)
14. Гаркуша І.П., Курінний В.П., Мостіпан Л.Ф. Фізика. Навчальний посібник для самостійної роботи студентів. – Дніпропетровськ: НГУ. 2011.
15. Гаркуша І.П., Мокляк З.П., Буслов Ю.О. Фізика. Задачі з розв'язаннями. – Дніпропетровськ. НГУ.2003.
16. Гаркуша І.П. Елементи фізики напівпровідників. Навчальний посібник: - Д.: Національний технічний університет «Дніпровська політехніка», 2022. – 80 с.
17. Певзнер М.Ш. Основи теорії відносності: навч. посіб. Дніпропетровськ: НГУ, 2013. 134 с.

WORK PROGRAM OF THE ACADEMIC DISCIPLINE

"Physics" for bachelors
141 «Electrical energetics, electrical engineering and electromechanics»

Authors:
Voronko Tetiana Yevhenivna
Zhuravlov Mykhailo Oleksandrovych

Edited by the authors

Prepared for publication
Dnipro University of Technology.
Certificate of registration in the State Register, control number 1842
49005, Dnipro, Dmytra Yavornytskoho Ave. 19