GENERAL PHYSICS 2

Work program of the academic discipline (Syllabus)

Course details	
Level of higher education	**First (bachelor's)**
Field of knowledge	G - Engineering, manufacturing, and construction
Special	G5 Electronics, electronic communications, instrument engineering, and radio engineering
Educational program	For all educational programs
Status of discipline	Mandatory
Form of study	Full-time (day)
Year of study, semester	2nd year, first semester
Scope of the discipline	120 hours (full-time: 16 hours – lectures, 30 hours – practical classes, 74 hours – independent study)
Semester control/control measures	Exam/MCR, RR
Class schedule	http://rozklad.kpi.ua
Language of instruction	Ukrainian
Information about course director / lecturers	Lecturer: Prof. Y.I. Dzhezheria, dui_kpi@ukr.net mobile +38(050)9681446 Practical Prof. Y.I. Dzhezherya, Assistant V.R. Lyakhovetsky dui_kpi@ukr.net, mobile +38(050)9681446
Course location	https://campus.kpi.ua, distance learning platform "Sikorsky"

Curriculum

Description of the course, its purpose, subject matter, and learning outcomes

Description of the discipline. Physics is the science of nature, of the most fundamental laws of motion of matter, its structure, properties, and interactions; it is based on establishing and explaining the laws governing the processes and phenomena of the surrounding world. Quality control of the knowledge gained is provided in the form of tests, calculations, and modular control works.

Subject of the academic discipline: General Physics.

Purpose of the academic discipline.

The purpose of the academic discipline is to develop the following competencies in students:

- the ability to think logically,
- generalization, analysis, perception of information, setting goals and choosing the right ways to achieve them,
- the ability to construct oral and written speech in a logically correct, reasoned, and clear manner,
- the ability to independently apply methods and means of cognition, learning, and self-control to acquire new knowledge and skills,
- the ability to formalize, present, and report the results of completed work,
- the ability to present a scientific picture of the world that is adequate to the current level of knowledge based on knowledge of the basic principles and laws of ,
- apply the basic principles and laws of classical and modern physics,
- operate with fundamental physical concepts and laws when solving physical problems,
- apply basic material for further study of disciplines in the cycle of professional and practical training.

Main objectives of the academic discipline

In accordance with the requirements of the educational and professional program, after mastering the academic discipline, students should:

know:

- the basic methods of physical research;
- the fundamental laws of classical and modern physics;
- the limits of application of various physical concepts, laws, and theories.

be able to:

- apply physical laws to solve practical problems;
- assess the degree of reliability of results obtained using experimental or theoretical research methods;
- experimentally investigate, qualitatively and quantitatively evaluate basic physical phenomena;
- use general scientific and special terminology correctly.

possess:

- skills in the practical application of the laws of physics;
- experience in conducting physical experiments and processing their results;
- skills in using standard methods and models to solve specific physical problems;
- skills in independent acquisition of knowledge using traditional and modern educational and information technologies;
- methods of approaching the solution of problems that arise in the course of professional activity, choosing research methods based on a scientific worldview.

Program learning outcomes:

Competencies:

SC 1. Ability to think abstractly, analyze, and synthesize;

SC 2. Ability to apply knowledge in practical situations

SC 4. Ability to understand the subject area and professional activity

FC 3. Ability to use basic methods, techniques, and means of obtaining, transmitting, processing, and storing information.

FC 4. Ability to perform computer modeling of devices, systems, and processes using universal application software packages.

International Telecommunication Union, etc.) to solve professional tasks.

FC 15. Ability to perform calculations in the process of designing structures and means of information and telecommunication networks, telecommunication and radio engineering systems, in accordance with technical specifications using both standard and independently created methods, techniques, and software tools for design automation.

PRN 1. Analyze, argue, and make decisions when solving specialized tasks and practical problems in telecommunications and radio engineering, which are characterized by complexity and incomplete certainty of conditions.

PRN 12. Apply fundamental and applied sciences to analyze and develop processes occurring in telecommunications and radio engineering systems.

Prerequisites and post-requisites of the discipline (place in the structural-logical scheme of training under the relevant educational program)

The study of this credit module is based on the disciplines of physics, mathematics, and chemistry in the scope of the secondary school program and the current material of the higher mathematics course. The knowledge gained by students from the General Physics course is used in the Electrodynamics and Radio Wave Propagation course.

Contents of the academic discipline

Section 4. Steady magnetic field. Variable electromagnetic fields.

4.1 Stationary magnetic field.

4.2 Law of electromagnetic induction.

4.3 Alternating electric current.

4.4. Currents in an oscillating circuit.

4.5. Maxwell's equations.

4.6 Motion of charged particles in an electromagnetic field.

Teaching materials and resources

Basic literature

1. Kucheruk I.M., Gorbachev I.I., Lutsky P.P. General Course in Physics. Optics. Quantum Physics. - K: Technika, 1999.
2. Kucheruk I.M., Gorbachev I.I. General Course in Physics. Electricity and Magnetism. - K: Technika, 2001.
3. General Physics. Electricity and Magnetism. Collection of Problems for Students of Technical Specialties. V.P. Brygynets, O.O. Guseva, O.V. Dimarova, et al. Kyiv: NTUU KPI. 2011. 52 p.
4. General Physics. Optics. Quantum Physics. Molecular Physics. Collection of Problems for Students of Technical Specialties. V.P. Brygynets, O.O. Guseva, O.V. Dimarova, et al. – Kyiv. NTUU KPI. 2010. – 50 p.
5. V. P. Brygynets, O. O. Guseva. Calculation work: "Electric field of charges in a vacuum."

Information resources

1. http://kzf.kpi.ua/
2. http://campus.kpi.ua/tutor/index.php
3. www.youtube.com/irepalov

Educational content

Methodology for mastering the academic discipline (educational component)

Lectures

Title, lecture topics, and list of key questions
Topic 4.1. Stationary magnetic field. Lecture 1-2. Biot-Savart law. Magnetic field of a moving charge. Field of volume and linear currents. Interaction of parallel conductors with current. Ampere's force. Unit of measurement of current in SI. The concept of vector circulation. Ampere's law of magnetic field circulation. Vector rotor. Magnetic field circulation equation in differential form. Magnetic fields of currents with model configurations (infinite wire, infinite plate, solenoid). Equations of magnetostatics. Boundary conditions for magnetic field and current. Field of a current-carrying loop. Magnetic dipole. Field of a current-carrying loop. Magnetic dipole moment. Loop with current in an external field. Magnetic field in matter. Magnets. Magnetization of matter. Dia-, para-, and ferromagnetism. Magnetic susceptibility and permeability of matter. Magnetic field intensity vector and its boundary conditions.
Topic 4.2 Law of electromagnetic induction. Lecture 3. Electromotive force. Integral and differential forms of the law of electromagnetic induction. Lenz's law. The phenomenon of self-induction. Inductance of a conductor. Self-induction EMF. Energy of a conductor with current. Current when closing and opening an RL circuit. The phenomenon of mutual induction. Mutual induction coefficient. Mutual induction emf. Current when closing and opening the CL circuit.
Topic 4.3. Alternating electric current. Lecture 4. Quasi-stationary current. Ohm's law for alternating current. Impedance. Kirchhoff's laws for alternating current. Active and reactive resistance. Power in an alternating current circuit. Effective values of current and voltage.
Topic 4.4. Currents in an oscillatory circuit. Lecture 5. Harmonic oscillations in a circuit. Types of oscillations. Free and forced oscillations. Harmonic oscillations. Oscillatory circuit. Oscillations in an ideal circuit, natural frequency of the circuit. Energy of oscillations in an ideal circuit. Free oscillations in a circuit with damping. Free damped oscillations in a circuit, frequency of damped oscillations. Damping characteristics. Energy dissipation in a circuit. Forced electrical oscillations. Forced oscillations in a circuit under sinusoidal influence. Amplitude and phase of forced oscillations. Resonance curves.

Topic 4.5. Maxwell's equations. Lecture 6-7. Vortex electric field and displacement current. Maxwell's equations. Fundamental and material equations. Plane electromagnetic waves. Monochromatic wave. Wave equation. Phase velocity of a wave. Properties of plane waves. Propagation of electromagnetic waves in dielectrics. Poynting vector, intensity of electromagnetic waves. Propagation of electromagnetic waves in conductors. Maxwell's equations for waves in conductors and their solution in the form of plane waves. Dispersion equation. Skin effect.
Topic 4.6. Motion of charged particles in electric and magnetic fields. Lecture 8. Motion of charge in a uniform electric field. Motion in a uniform magnetic field. Cyclotron frequency. Motion in crossed fields. Drift of particles. Accelerators of charged particles.

Practical classes

No	Name of the topic and list of main questions
1	Topic 4.1. Magnetic field of a system of currents (superposition principle). Biot-Savart law.
2	Topic 4.1. Determination of magnetic fields using the circulation theorem.
3	Topic 4.1. Ampere's force. Magnetic moment. Contour
4	Topic 4.2. Magnetic flux. Law of electromagnetic induction.
5	Topic 4.2. Inductance and self-induction. Self-induction EMF. Mutual induction
6	Topic 4.3. Alternating electric current. Quasi-stationary current. Ohm's law for alternating current. Power in an alternating current circuit
7	Topic 4.4. Free electrical oscillations.
8	Topic 4.4. Forced electrical oscillations.
9	Topic 4.5. Maxwell's equations. Vortex electric field and displacement current.
10	Topic 4.6. Motion of charge in electric and magnetic fields.
11	Conducting MCR
12	Topic 4.5. Electromagnetic waves. Properties of plane waves.
13	Interference
14	Diffraction
15	Polarization and dispersion

Calculation work:

In order to improve the quality of learning and develop initial experience in engineering calculations, a calculation assignment (CA) on the topic "Magnetic fields of currents in a vacuum" is provided.

Policy and control

Policy of the academic discipline (educational component)

System of requirements for students:

- attendance at lectures and practical classes is a mandatory part of studying the material;
- the lecturer uses their own presentation materials during lectures; uses Google Drive and the Sikorsky distance learning platform to teach the material of the current lecture, provide additional information, assign practical work, etc.;
- questions during lectures are asked during the time allotted for this purpose;
- to defend a practical or computational assignment, it is necessary to solve the corresponding problems and answer questions about the solution;

- Modular tests are written during practical classes without the use of auxiliary means (mobile phones, tablets, etc.).
- bonus points are awarded for: independent original solutions to problems in practical classes; participation in faculty and institute competitions in academic disciplines, participation in contests, certificates of completion of distance or online courses. The number of bonus points is limited to 10;
- Penalty points are awarded for: cheating on a module test or calculation work. The number of penalty points shall not exceed 10.

Types of control and rating system for assessing learning outcomes (RSO)

The rating of a full-time student consists of points that he or she receives for:

1. modular tests/online tests;
2. calculations;
3. work in practical classes;
4. exam answers;
5. bonus points.

The rating of a part-time student consists of points that he receives for:

1. completion and defense of homework assignments;
2. completion and defense of a modular test;
3. solving problems in practical classes and completing homework assignments;
4. answers on exams;
5. bonus points

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Rating point system and assessment criteria

Full-time education:

Calculation work:

Weighted score RR = 15 with the following assessment criteria:

- 0 points - work not submitted within a month after the deadline (not counted);
- 1 - 3 points - the work contains gross errors in each task (not counted);
- 4 - 6 points - the work contains gross errors that require reworking (not counted);
- 7 - 11 points - the work contains some significant errors, but does not require complete reworking (accepted);
- 12 - 15 points - the work is generally correct, has no significant flaws or comments (passed).

Practical classes:

The total weighted score for practical classes during the semester is R_{pr}= 10 points, which is calculated as the average of the number of grades, with the following assessment criteria for the class:

0 points - complete unpreparedness for the class (lack of basic knowledge on the topic of the class);
1– 2 points - unsatisfactory preparation for the class;
3-5 points - satisfactory preparation for the class;
6–8 points – well prepared for class;
9 - 10 points - excellent preparation for the lesson.

Homework assignments:

The total weighted score for homework assignments during the semester is $R_{homework}$= 10 points, which is calculated as the average of the number of grades, with the following assessment criteria for the class:

0 points - homework not completed
1– 2 points - unsatisfactory homework;

3 - 5 points - satisfactory homework;
6 - 8 points - well-done homework;
9–10 points - excellent homework.

Modular tests/quizzes:

Ongoing assessment of knowledge is carried out throughout the semester in the form of written tests.

Total weighted score for MCR

$$R_{mkr} = 25 \text{ points.}$$

Incentive points R_z :

are awarded for creative work in the credit module (e.g., participation in faculty and institute academic competitions, participation in contests, certificates of completion of distance or online courses, active participation in practical classes), but no more than 10 in total.

Rating scale for the discipline (full-time education) $R_D = 100$ points and is formed from the total weighted score for work during the semester (starting rating) R_C and the examination component R_E :

$$R_D = R_C + R_E$$

According to the above

$$R_C = R_{pr} + R_{dz} + R_{rr} + R_{mkr} = 60 \text{ points} + R_z$$

where

R_{pr} – points for practical tasks (0…20);
R_{mkr} – points for writing MCR/TESTS (0…25);
R_{pp} – points for writing a calculation assignment (0…15);
R_z – incentive points (0…10);

The exam component accounts for 40% of the rating scale and amounts to

$$R_E = 40 \text{ points.}$$

Conditions for admission to the exam:

A student is admitted to the exam if they:

- has a starting rating $R_C > 0.5\ R_C$, i.e. $R_C > 30$ points;
- have completed the calculated work.

Exam grading system:

- answers to all questions on the exam paper are missing or contain gross errors and do not meet the minimum required level of mastery of the material 0 - 9 points;
- data generally correct answers to at least 25% of the test questions 10 - 17 points
- correct answers in at least 50% of the test questions 18 - 27
- correct answers to at least 75% of the test questions 28–35
- Comprehensive, well-reasoned answers to all questions on the exam 36–40

The sum of RD points or points for coursework is converted to a course grade according to the table:

Table. Conversion of rating points to grades on the university scale

Number of points	Grade
100-95	Excellent
94	Very good
84	Good
74-65	Satisfactory

64-60	Sufficient
Less than 60	Unsatisfactory
Admission requirements not met	Not admitted

Work program for the academic discipline (Syllabus):

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Approved by the Department of General and Theoretical Physics No. 5 on 27.05.2025

Approved by the Methodological Commission of the Radio Engineering Faculty (Minutes No. 06-2025 dated 26.06.2025)