Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of General Physics

GENERAL PHYSICS 2

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	***First (undergraduate)*** *14*
Field of	*Electrical engineering*
knowledge	*141 Power engineering, electrical engineering and electromechanics*
Specialty Educational program	*Electromechanical automation systems, electric drive and electric mobility*
Status of the	*Normative*
discipline Form of	*Daytime*
study Year of training,	*1st year, autumn and spring semester*
semester Scope of	*3.5 credits*
the discipline Semester control/ control measures	*Exam / MKR, RGR*
Class schedule	*The time and place of classroom classes are listed on the website http:// rozklad.kpi.ua/*
Language of	*Ukrainian*
instruction Information about the course leader / teachers	Lecturer: *Art. off Samar Anna Volodymyrivna, anna.samar@gmail.com, 0679189012* Practical: *art. off Samar Anna Volodymyrivna, anna.samar@gmail.com, 0679189012* Laboratory work: *Art. off Samar Anna Volodymyrivna, anna.samar@gmail.com, 0679189012; assistant Eduard Vasylovich Lukyanenko, eduardlukianenko@gmail.com, 0977345910*
Placement of the course	*CAMPUS, Platform Sikorsky ("General Physics")*

Program of educational discipline

1. Description of the educational discipline, its purpose, subject of study and learning outcomes

The purpose of the educational discipline is to form and consolidate the acquirers' competencies, skills and abilities regarding the use of basic physical laws and research methods when studying engineering and professional disciplines and solving engineering problems.

The subject of the academic discipline is matter and the most general forms of its existence, movements and fundamental interactions that control the movement of matter, as well as the laws, methods and means of physics as components of the research process.

The discipline "General physics" belongs to the disciplines of the cycle of general training and is studied by students in the 1st and 2nd semesters of study in the specialty 141 Electric power engineering, electrical engineering and electromechanics. This discipline contributes to the formation of students' basic concepts, abilities and skills regarding the processes, phenomena and laws of physics. In particular,

ABILITY:

- *combine the physical essence of natural phenomena with analytical relationships that describe these phenomena;*

• *connect the macroscopic description of phenomena with their microscopic mechanisms;*
• *correctly assess the limits of applicability of physical laws and principles*
the possibility of certain phenomena;

After mastering the academic discipline, students must demonstrate the following learning outcomes:

KNOWLEDGE:

• *fundamental concepts, laws and theories of classical and modern physics;*
• *conceptual approaches to the study of physical phenomena;*
• *basics of classical mechanics;*
• *basics of molecular physics and thermodynamics;*
• *basics of electricity and magnetism;*
• *fundamentals of oscillatory and wave processes;*
• *fundamentals of quantum, atomic and nuclear physics;*
• *methods of solving physics problems.*

SKILLS:

• *analyze educational and educational and methodological literature, use it in the educational process;*
• *determine the optimal methodology for solving problems and setting up experiments in physics;*
• *analyze and interpret the obtained results of problem solving;*
• *analyze the results of observations and experiments using the basic laws of physics, use physical devices*
• *find connections and make marginal transitions from the obtained results to known data obtained from simpler models;*
• *present the material logically and consistently, substantiate their statements.*

Program learning outcomes.

Competencies:

K01. Ability to abstract thinking, analysis and synthesis.
K02. Ability to apply knowledge in practical situations.
K05. Ability to make informed decisions.
K06. Ability to identify, pose and solve problems.
K07. Ability to work in a team.
K08. Ability to work autonomously.
K12. The ability to solve practical problems involving the methods of mathematics, physics and electrical engineering.
K20. Ability to apply new technologies in electric power, electrical engineering and electromechanics.

Program learning outcomes:

PR 03. Know the principles of operation of electric machines, devices and automated ones electric drives and be able to use them to solve practical problems in professional activities.

PR 05. Know the basics of electromagnetic field theory, methods of calculating electric circuits and be able to use them to solve practical problems in professional activities.

PR 08. Choose and apply suitable methods for the analysis and synthesis of electromechanical and electric power systems with specified indicators.

PR 10. Find the necessary information in scientific and technical literature, databases and other sources of information, evaluate its relevance and reliability.

PR 18. To be able to learn independently, acquire new knowledge and improve the skills of working with modern equipment and measuring equipment.

2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to corresponding educational program)

The discipline "General physics" belongs to the disciplines of the cycle of natural and scientific training, its study is based on knowledge of physics and mathematics according to the secondary school program. The knowledge obtained during the study of the general physics course is used in the study of the following disciplines: "technical mechanics", "theoretical foundations of electrical engineering", "electric machines", "electromechanical materials", "electrical systems and networks", "fundamentals of metrology and electrical measurements", "ecology" and courses of other disciplines of the cycle of professional and practical training.

3. Content of the academic discipline

Credit module 1.

Chapter 1. Physical foundations of mechanics.

1.1. Elements of kinematics.

1.2. Dynamics of a material point.

1.3. Law of conservation of momentum.

1.4. Law of conservation of energy.

1.5. Dynamics of rotational motion of a rigid body.

1.6. The law of conservation of momentum.

1.7. The principle of relativity in mechanics.

1.8. Special theory of relativity.

1.9. Elements of relativistic dynamics.

1.10. Elements of mechanics of continuous media.

Chapter 2. Fundamentals of molecular physics and thermodynamics.

2.1. Thermodynamic and molecular-kinetic approaches in the study of thermal properties of bodies (systems).

2.2. The second law (second law) of thermodynamics.

2.3. Transference phenomena.

2.4. Real gases.

2.5. liquids

2.6. Phase equilibria and transformations.

2.7. Solid body.

Chapter 3. Electricity and magnetism.

3.1. Electrostatic field in vacuum.

3.2. A dielectric in an electrostatic field.

3.3. Conductors in an electrostatic field. 3.4. Electric field energy. 3.5. Direct current. ***Credit module 2.***

Chapter 3. Electricity and magnetism (continued). *3.6. The magnetic field of direct currents in a vacuum. 3.7. Electromagnetic induction. 3.8. Magnetic field in matter. 3.9. Maxwell's equation. Electromagnetic field.*

Chapter 4. Oscillations and waves.

4.1. Oscillating motion. 4.2. Wave processes.

Chapter 5. Wave and quantum optics.

5.1. The electromagnetic nature of light. 5.2. Interference of light. 5.3. Diffraction of light. 5.4. Polarization of light. 5.5. Dispersion of light. 5.6. Quantum nature of radiation. 5.7. Phenomena related to the corpuscular properties of light.

Chapter 6. Elements of atomic physics and quantum mechanics *6.1. Bohr's theory of the structure of the atom. 6.2. Elements of quantum mechanics.*

Chapter 7. Elements of the physics of the atomic nucleus and elementary particles.

7.1. Core structure. Nuclear reactions. 7.2. Elementary particles. A list of sections and topics of the entire ***discipline is provided.***

4. Educational materials and resources

Basic literature

1. Kucheruk I.M., Gorbachuk I.T., Lutsyk P.P. General course of physics. T.1 Mechanics. Molecular physics and thermodynamics. - K.: Technika, 2004.

2. Kucheruk I.M., Gorbachuk I.T., Lutsyk P.P. General course of physics. T.2 Electricity and magnetism. - K.: Technika, 2004.

3. Kucheruk I.M., Gorbachuk I.T., Lutsyk P.P. General course of physics. T.3 Optics. Quantum physics. - K.: Technika, 2004.

4. Physics (Physics for engineers): Textbook / I.F. Skitsko, O.I Skitsko: Kyiv: Ihor Sikorsky National Technical University of Ukraine, 2017. 513 p.

5. Basic guide Bratus T.I., Samar G.V. General physics. Electromagnetism. 2022 - K: KPI, 2022 (https://ela.kpi.ua/handle/123456789/47985).

Supporting literature

6. General course of physics. Collection of problems. / under the editorship Prof. Harkushi I.P./ - K: Technology, 2003.

7. Cherkashin V.P. Methodical instructions for laboratory works in physics / electricity and magnetism/ ch.h. 1, 2 – K: KPI, 2000.

8. Methodical instructions for laboratory works in physics. Molecular physics. – To: KPI, 2014.

9. Landsberg G.S. Optics. - M.: FML, 2003.

Wenger E.F., Hryban V.M., Melnychuk O.V. Fundamentals of quantum mechanics. Study guide. - K: Higher School, 2002.

10. White M.U. , Okhrimenko B.A. - Atomic physics. - K: Znannia, 2009.

Information resources:

1. Electronic campus of KPI named after Igor Sikorskyi, methodical support for the credit module "General Physics".

2. "Sikorskyi" platform, distance course "General Physics"

3. Online library of Igor Sikorsky KPI https:// ela.kpi.ua/

Recommendations and clarifications:

- *the textbooks specified in the list can be obtained in the library of KPI named after Igor Sikorsky (subscription or reading room), on the Internet on the page of the Department of General Physics kzf.kpi.ua or on the pages of online libraries;*
- *the student should use the given materials for independent preparation for practical, laboratory classes and writing MKR;*
- *for independent work on the Sikorsky platform, the synopsis of the lectures is posted accordingly to the topics being studied.*
- *Methodical instructions, protocols for laboratory works can be found in the classroom on the Sikorsky platform and on the website https:// kzf.kpi.ua/ laboratornyj-praktykum/*

Educational content

5. Methods of mastering an educational discipline (educational component)

The educational part of the discipline consists of lecture material, practical classes and control measures in the form of MKR. The material is divided into thematic components according to the order of study. Each such part is structured according to the types of activities necessary to master the subject: theoretical part (lectures, video materials), practical part (methodical guides for solving problems, examples of solutions, tasks for independent work), laboratory practice (work protocols, video materials, reference information, tasks for independent work). Thus, a comprehensive approach to the study of individual topics and the subject as a whole is provided. And also provides a general methodical approach to the teaching of the academic discipline as communicative-cognitive and professionally-oriented, according to which the student is at the center of the educational process - subject of study and future specialist.

Lecture classes

No. z/p	The name of the topic of the lecture and a list of main questions
1	Chapter 3, topic 3.6. The magnetic field of direct currents in a vacuum. Relativistic nature of magnetic interaction. Magnetic field. Magnetic induction. Ampere's law. Current magnetic field. Biot-Savard-Laplace law and its application for calculations of the magnetic field of the simplest systems. Magnetic moment of a coil with a current in a non-uniform magnetic field. Interaction of two parallel currents. The unit of current is the ampere. The work of moving a conductor with a current in a magnetic field. Magnetic flux. Gauss' theorem for the magnetic field. Theorem on the circulation of the magnetic field in a vacuum. The field of an infinite solenoid. [2] vol. 2, § 8.1-8.15.
2	Chapter 3, topic 3.7. Electromagnetic induction. The phenomenon of electromagnetic induction (Faraday's experiment). Lenz's rule. The law of electromagnetic induction and its derivation from the law of conservation of energy. The electronic mechanism of induction electromotive force. The phenomenon of self-induction, inductance, solenoid inductance. Currents during closing and opening of an electric circuit. The phenomenon of mutual induction. Mutual inductance. Energy of the system of conductors with current. Volume density of magnetic field energy. [2] vol. 2, § 10.1-10.6.
3	Chapter 3, topic 3.8. Magnetic field in matter. Magnetic moments of atoms. Types of magnets. Magnetization. Micro and macro currents. Ampere's hypothesis. Elementary theory of dia- and paramagnetism. Magnetic susceptibility of a substance (body) and its dependence on temperature. Magnetic field strength. Magnetic permeability of the medium. Conditions at the boundary of two environments. Ferromagnets. Magnetization curve. The nature of ferromagnetism. [2] vol. 2, § 9.1-9.13.
4	Chapter 3, topic 3.9. Maxwell's equation. Maxwell's interpretation of the phenomenon of electromagnetic induction. The system of Maxwell's equations in integral and differential forms. [2] vol. 2, § 13.1-13.4.
5	Chapter 4, topic 4.1. Oscillating motion. Oscillation and its characteristics. Harmonic oscillation and its sign. The differential equation of undamped harmonic oscillation. Elastic, physical, mathematical pendulums. Electric oscillating circuit. Energy of harmonic oscillations. Compilation of harmonic oscillations of one direction and

	one frequency Beating. Addition of mutually perpendicular oscillations. Lissajous figures. Damping oscillations. Differential equation of damped oscillations and its solution. *[1] vol. 1, § 10.1-10.11*
6	*Chapter 4, topic 4.1.* *Oscillating motion. (continuation). Attenuation coefficient. Logarithmic decrement, Q factor. Aperiodic process. Forced oscillations. Differential equation of forced oscillations and its solution. A graphic method of determining the amplitude of established forced oscillations. Resonance. Concept of parametric oscillations. Parametric resonance.* *[2] vol. 2, § 11.1-11.10, § 12.1-12.5.*
7	*Chapter 4, topic 4.2.* *Wave processes. The mechanism of waves in elastic media. Longitudinal and transverse waves. Sine waves. The traveling wave equation. Wavelength and wave number. Plane and spherical waves. Wave equation. Phase speed of the wave. The principle of wave superposition and the limits of its applicability. Wave packet. Group speed. Coherence. Interference of waves. The formation of a standing wave. Standing wave equation and its analysis. Differential equation of electromagnetic waves. Monochromatic electromagnetic wave. Electromagnetic field energy. Energy flow. The Poyting Condition vector. Dipole radiation.* *[2] vol. 2, § 14.1-14.11.*
8	*Chapter 5, topic 5.1.* *The electromagnetic nature of light. The mechanism of waves in an elastic medium. Longitudinal and transverse waves. The structure of a plane electromagnetic wave and its representation in a complex form. Monochromatic and non-monochromatic radiation. Propagation, reflection and refraction of light waves in isotropic media. Huygens' principle.[5] vol. 2, § 104-118.* *Chapter 5, topic 5.2.* *Interference of light. Interference of monochromatic and quasi-monochromatic waves. Methods of obtaining coherent beams of light. Interference pattern from two coherent light sources. Coherence in time and space. The effect of non-monochromatic light on the interference pattern. Interference bands of equal slope and equal thickness. Application of interference, interferometers.* *[3] vol. 3, § 1.1-1.6, § 3.1-3.7.*
9	*Chapter 5, topic 5.3.* *Diffraction of light. Diffraction phenomena. Fresnel diffraction. Fraunhofer diffraction. The Huygens-Fresnel principle. Fresnel zone method. Fresnel diffraction on a round hole. Fraunhofer diffraction on one slit and a diffraction grating. Diffraction on a spatial grating. Diffraction of X-rays. The concept of holography. [5] vol. 2, § 125-133.* *Chapter 5, topic 5.4.*

	Polarization of light. Types of polarization. Polarization of light during reflection and refraction at the interface of two transparent dielectrics. Brewster's Law. Double refraction in crystals. The degree of polarization. Polarizing devices. Interference of polarized light. *[3] vol. 3, § 4.1-4.6, § 5.1-5.9.*
10	*Chapter 5, topic 5.5.* *Dispersion of light. The concept of light dispersion. Normal and abnormal variance. Electronic theory of light dispersion. Light propagation in anisotropic media. Scattering of light. The nature of scattering processes.[3] vol. 3, § 6.1-6.8, § 7.1-7.4, § 8.1-1.3.* *Chapter 5, topic 5.6.* *Quantum nature of radiation. Thermal radiation. Absolutely black body. Kirchhoff's law. Stefan-Boltzmann law. Energy distribution in the radiation spectrum of an absolutely black body. Wien's law, Wien's displacement rule. Quantum hypothesis and Planck's formula. Derivation of Stefan-Boltzmann, Wien, Rayleigh-Jeans laws from Planck's formula. Optical pyrometry.* *[3] vol. 3, § 11.1-11.4.*
11	*Chapter 5, topic 5.7.* *Phenomena related to the corpuscular properties of light. Photoelectric effect and its regularities. Einstein's equation. Photocells, photomultipliers and their application. Lebedev's experiments. Mass and momentum of a photon. Internal photo effect. Direct experimental confirmation of the existence of photons (Bote experiment). Compton effect and its explanation.* *[3] vol. 3, § 9.1-9.5.*
12	*Chapter 6, topic 6.1.* *Bohr's theory of the structure of the atom. Atom models of Thomson, Rutherford. Failure of the classical theory of the structure of the atom. Experiments of Frank and Hertz. Discreteness of energy levels in an atom. Bohr's postulates. Hydrogen atom and its spectrum according to Bohr's theory. The Bohr model of the atom. Quantum numbers. Limitation of Bohr's theory. Experimental substantiation of corpuscular-wave dualism. De Broglie's hypothesis and formula. Uncertainty ratio as a manifestation of particle-wave dualism of matter. Estimation of the linear dimensions of the hydrogen atom. Limitation of mechanical determinism.* *[3] vol. 3, § 12.1-12.6, § 13.1-13.4.*
13	*Chapter 6, topic 6.2.* *Quantum states. Schrödinger's equation. Setting the state in quantum mechanics. Wave function and its statistical meaning. The concept of operators of physical quantities. Eigenvalues of operators. The general Schrödinger equation. The principle of causality in quantum mechanics. Stationary states. Schrödinger's equation for steady states. A particle in a one-dimensional and three-dimensional "potential box".* *[3] vol. 3, § 14.1-14.5.*

14	Chapter 6, topic 6.2. Tunnel effect. Pauli principle. Passage of a particle through a potential barrier. Tunnel effect. Harmonic oscillator. Quantization of energy and momentum. Hydrogen-like atoms. Energy spectra. Excitation and ionization potentials. Spatial distribution of an electron in a hydrogen atom. Energy level width. Momentum momentum in quantum theory. The experiments of Stern and Gerlach. Electron spin. Spin quantum number. The principle of indistinguishability of identical particles. Pauli principle. [3] vol. 3, §213.5-13.7.
15	Chapter 6, topic 6.2. Spectra of atoms and molecules. Distribution of electrons in an atom by states. The structure of electronic levels in complex (multi-electron) atoms. D. I. Mendeleev's periodic system of elements. The concept of energy levels of molecules. Spectra of atoms and molecules. Stark and Zeeman effects. X-rays. Solid X-ray spectrum and its short-wavelength limit. Characteristic spectrum. Moseley's Law. X-ray defectoscopy. [3] vol. 3, § 13.6-13.13.
16	Chapter 6, topic 6.2. Interaction of atoms and molecules. The main types of interatomic bond. Ionic bond. Covalent bond and concepts of the theory of exchange forces. Metal connection. Splitting energy levels of electrons of isolated atoms during the formation of molecules. The main components of molecular spectra (electronic, vibrational and rotational spectra). Absorption, spontaneous and forced radiation. Quantum amplifiers and radiation generators. [] vol. 3, § 14.5-14.7.
17	Chapter 6, topic 6.2. Quantum properties of solids. Quantum properties of solids. Periodicity of the potential and one-electron functions for the crystal lattice. Zone models of metals, semiconductors, dielectrics. Elementary processes in gases and plasma. Laser spectroscopy and its application in atomic physics. [3] vol. 3, § 14.7-14.8.
18	Chapter 7, topic 7.1. Core structure. Nuclear reactions. Mass spectrometers and determination of nuclear masses. Isotopes. Isomers. Isobars Mechanical and magnetic moments of nuclei. Paramagnetic nuclear resonance. The structure of the atomic nucleus. Phenomenological models of the nucleus: gas, droplet, shell. The constituent parts of the atomic nucleus are nucleons, their mass, spin. Interconversion of nucleons. Neutrino. The origin of ÿ is radiation. The interaction of nucleons and the concept of nuclear forces. Mass defect. Bond energy, stability of nuclei. Excited states of the core. Spectra ÿ - radiation. Mössbauer effect. Mechanism of absorption of ÿ-rays by matter. Positron. Passage of neutrons through matter. Chapter 7, topic 7.2.

	Elementary particles. The concept of elementary particles. Particles of high energies. Cosmic rays and methods of their research. Modern methods of acceleration of elementary particles: linear accelerator, cyclotron, synchrocyclotron, synchrophazotron, betatron. Interaction of fast particles with matter. Mesons. Antiparticles (antiproton, antineutron). Classification and mutual transformation of elementary particles. The problem of elementary particles in modern physics. *[3] vol. 3, § 15.1-15.19.*

Laboratory work

The purpose of the laboratory classes is the formation of students' practical skills for working in a physical laboratory - understanding the observed processes, using measuring devices, processing the obtained results - necessary in the process of further education and independent work.

Protocols of laboratory work can be found at the link https:// kzf.kpi.ua/ laboratornyj-praktykum/ , as well as in the classroom on the Sikorsky platform.

No s/ p	*The name of the laboratory work*	*Number audio hours*
1	*Determining the work of electron release from a metal.*	*2*
2	*Study of hysteresis of ferromagnetic materials.*	*2*
3	*Study of damping oscillations in an oscillating circuit.*	*2*
4	*Study of forced oscillations in an oscillating circuit.*	*2*
5	*Study of light interference using a Fresnel biprism. 2*	
6	*Study of diffraction of light at a slit.*	*2*
7	*Study of polarized light.*	*2*
8	*Study of the laws of thermal radiation.*	*2*
9	*Study of the spectrum of the hydrogen atom.*	*2*

6. Independent work of the student

The student's independent work is the main means of assimilating the educational material free time from educational classes and includes:

No. z/p	Type of independent work	Number hours of SRS
1	Implementation of RGR	15
2	Preparation for MKR	6
3	Preparation for the exam	30

Policy and control

7. Policy of academic discipline (educational component)

The system of requirements that the teacher sets before the student:

*- **rules for attending classes:** in accordance with Order 1-273 dated 14.09.2020, it is prohibited to evaluate the presence or absence of the winner in the classroom class, including awarding incentive or penalty points. According to the RSO of this discipline, points are awarded for the corresponding types of educational activity in practical classes. - **rules of behavior in classes:** the student must properly follow the teacher's instructions regarding work in the class, behave discreetly and politely and not disturb other students and the teacher. The use of means of communication to search for information on the teacher's Google Drive, on the Internet, in a distance course on the Sikorsky platform is carried out on the condition that the teacher instructs;*

*- **policy of deadlines and rescheduling:** if a student did not pass or did not show up for the test (without a valid reason), his result is evaluated at 0 points. Completion of the test work is considered successful if the student received at least 50% of the maximum number of points for it. In the case of missing a test without a valid reason or failing to pass a test, rewriting the test is carried out in agreement with the teacher, while the maximum grade that the student can receive for the test is reduced by 2 points in relation to passing the test on time;*

*- **academic integrity policy:** the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute" https://kpi.ua/files/honorcode.pdf establishes general moral principles, rules of ethical behavior of individuals and provides a policy of academic integrity for individuals, who work and study at the university, which they should be guided by in their activities, including when studying and preparing control measures in the discipline "General Physics";*

*- **when using digital means of communication with the teacher** (mobile communication, e-mail, correspondence on forums and social networks, etc.), it is necessary to observe generally accepted ethical norms, in particular, to be polite and limit communication to the working hours of the teacher.*

8. Types of control and rating system for evaluating learning outcomes (RSO)

Types of control:

***Current control:** MKR.*

***Calendar control:** conducted twice a semester as a monitoring of the current state of fulfillment of the syllabus requirements.*

***Semester control:** exam.*

Conditions for admission to semester control: *successful completion of all control tasks, semester rating of at least 30 points.*

In the first lesson, students get acquainted with the rating system of evaluation (RSO) of the discipline, which is built on the basis of the "Regulations on the system of evaluation of learning results", https://document.kpi.ua/files/2020_1-273.pdf.

A rating system for evaluating learning outcomes

1. ***The rating of the student*** *from the credit module is calculated from 100 points, of which 60 points make up the starting scale. The starting rating (during the semester) consists of points that the student has receives for:*

1) Three control papers (MKR is divided into 3 control papers with a duration of 0.67 Acad. hours);
2) protection of 6 laboratory works;
3) performance and protection of calculation and graphic work;
4) the answer to the exam.

2. ***Scoring criteria***

Tests: Weighted score – 6.

The maximum number of points for the three components of the MKR is 6 points × 4 = 24 points.

"Excellent" - 6 points.
"Good" - 5 points.
"Satisfactory" - 3-4 points.
"Unsatisfactory" - 0 - 2 points.

Laboratory works: The Weight score – 4.

maximum number of points for all laboratory works is equal to 4 points × 6 = 24 points.

Performance of laboratory work - 1 point.
Protection of work calculations - 1-3 points.
A complete answer at the colloquium - 2 points.
An incomplete answer at the colloquium - 1 point.
Absence at the colloquium - (-2) points.

Execution and protection of calculation and graphic work: The maximum Weight score – 12.

number of points for calculation work is 12 points.

"Perfectly" 11.4 - 12 points.
ÿVery goodÿ 10.2 - 11.4 points.
ÿGoodÿ 9.0 - 10.1 points.
"Satisfactory" 7.8 - 8.9 points.
ÿEnoughÿ 6.0 - 7.7 points.
ÿUnsatisfactoryÿ 0 - 5.9 points.

3. The condition of the first attestation is obtaining at least 10 points and successful completion of all control and laboratory work at the time of attestation. The condition of the second attestation is to obtain at least 20 points, to perform all control and laboratory work during the attestation.

4. The condition for admission to the exam is the successful completion of all control tests and laboratory tests as well as a starting rating of at least 30 points. 5. At the exam, students prepare short written calculations and give an oral answer. Each task contains two theoretical questions. Each question in the ticket is valued at 20 points according to the following criteria:

- "excellent", complete answer, at least 90% of the required information (complete, error-free solving the task) – 20-17 points;

- "good", sufficiently complete answer, at least 75% of the required information or minor inaccuracies (complete solution of the task with minor inaccuracies) - 16-13 points;

- "satisfactory", incomplete answer, at least 60% of the required information and some errors (task completed with certain shortcomings) - 12-8 points;

- "unsatisfactory", the answer does not meet the conditions for "satisfactory" - 0 points.

For an objective assessment of the student's knowledge, the teacher has the right to ask additional questions from the course program that are not included in the ticket.

6. The sum of the starting points and points for the examination work is transferred to the examination grade according to the table:

Number of points	Rating
100...95	Perfectly
94...85	Very good
84...75	Good
74...65	Satisfactorily
64...60	Enough
Less than 60	Unsatisfactorily
There are ungraded test papers or a starting rating of less than 30 points	Not allowed

9. Additional information on the discipline (educational component)

- *The list of questions is provided in the Electronic Campus of KPI named after Igor Sikorsky and in the folder course on the "Sikorsky" platform.*
- *Certificates of completion of distance or online courses on the relevant subject can be credited provided that the requirements specified in ORDER No. 7-177 DATED 10.01.2020 "On approval of the regulation on recognition in KPI named after Igor Sikorskyi of learning outcomes acquired in non-formal/ informal education".*

Working program of the academic discipline (syllabus):

Compiled by senior teacher Samar Hanna Volodymyrivna, senior teacher Zakharchenko Roman Valeriyovych.

Approved by the Department of General Physics of the Faculty of Physics and Mathematics (protocol No. 7 dated June 6, 2023)

Agreed by the Methodical Commission of the Faculty of Electrical Power Engineering and Automation (protocol No. 10 of 22 .06.2023)