6B05302-Physics

1. OPTIONAL COMPONENTS OF THE CYCLE OF CORE COURSES

Optional component 1

Course: **Mathematical analysis and analytical geometry**
Intensity of the Course: 5 academic credits
Module Code: FHM-5
Module Name: Fundamentals of higher mathematics
Prerequisites: Basic algebra and analysis (school course).
Purpose: familiarization of students with the basic concepts, tasks and methods of analytical geometry and linear algebra, as well as their role and use in other mathematical and special disciplines, practical applications.
Short Description: Mathematical analysis and analytical geometry Fundamentals of mathematical analysis, differential and integral calculus, elements of field theory, theory of differential equations, theory of series, theory of functions of a complex variable, operational calculus, lines and surfaces of the second order, matrices, methods for solving a general system of linear equations, linear operators, bilinear functions and quadratic forms in Euclidean space.
Learning Outcomes in EP (LOP):
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;
LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;
Learning Outcomes in Course (LOC):
LOC 1 - mastering theoretical knowledge in the sections of vector algebra, analytical geometry on the plane and space.
LOC 2 - formation of skills in the sections of vector algebra, analytical geometry on the plane and space
LOC 3 - be able to apply knowledge, skills, and skills in vector algebra, the theory of analytical geometry on the plane and space when solving problems in the relevant fields
LOC 4 - be able to apply the acquired knowledge in their field, in science or in other industries.
Post requisites: Differential equations.

Optional component 1

Course: **Algebra and Number Theory**
Intensity of the Course: 5 academic credits
Module Code: FHM-5
Module Name: Fundamentals of higher mathematics
Prerequisites: Basic algebra and analysis (school course).
Purpose: Providing information (definitions, formulas, theorems, connections between them and methods of solving problems) necessary for the development of logical thinking of the student and the formation of mathematical culture, which is especially important for the study of other disciplines.
Short Description: The course materials are used in the study of differential geometry, topology, functional analysis, differential equations and many other disciplines that are necessary for solving practical physical problems. This determines the relevance of its study. The course has a general scientific and professional orientation. The discipline studies various methods of conducting logical proofs, as well as methods for solving professional problems in the field of algebra and number theory.
Learning Outcomes in EP (LOP):
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;
Learning Outcomes in Course (LOC):
LOC 1 Knowledge of the basic concepts and results studied in the discipline; the basic concepts and conclusions of the results; methods for solving given problems in algebra and number theory.

LOC 2 - Apply theoretical and practical knowledge in the discipline being studied and in the discipline in which the materials of this discipline are used to solve problems of various levels transmitted by the dda; be able to analyze the results obtained.

LOC 3 - Be able to build a mathematical model and perform appropriate numerical calculations.

Post requisites: Theory of functions of a complex variable.

Optional component 2

Discipline: **Differential equations**

Intensity of the Course: 5 academic credits

Module Code: FHM-5

Module Name: Fundamentals of higher mathematics

Prerequisites: Mathematical analysis and analytical geometry

Purpose: formation and development of competencies of a future mathematics teacher in the theory and practice of solving the main types of differential equations arising in various fields of natural science..

Short description: The course is aimed at the formation of systematic knowledge in the field of mathematical modeling of practical problems and their solution based on classical methods and techniques for solving differential equations; to form an idea of the basic concepts of the theory of ordinary differential equations, the mathematical apparatus used in solving differential equations

Learning Outcomes in EP (LOP):

LOP 5 – Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software

LOP 6 – Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models

Learning Outcomes in Course (LOC):

LOC 1 - Knows the basic concepts of the theory of differential equations;

LOC 2 - is able to classify differential equations and use the methods necessary to solve these equations;

LOC 3-possesses methods of approximate solution of differential equations using classification of functions in power series and trigonometric series.

Post requisites: Workshop on solving physical problems of increased complexity

Optional component 2

Discipline: **Theory of functions of a complex variable**

Intensity of the Course: 5 academic credits

Module Code: FHM-5

Module Name: Fundamentals of higher mathematics

Prerequisites: Theory of functions of a complex variable.

Purpose: developing students' skills of working with objects of a more complex structure than real numbers and their functions.

Short description: The study of the discipline is a necessary condition for the formation of the scientific Outlook of the future mathematics. The course is aimed at forming systematic knowledge in the field of the theory of functions of a complex variable, extending to the complex domain of the basic concepts used in real analysis, such as function, limit, continuity, differentiability, integrability.

Learning Outcomes in EP (LOP):

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;

LO 9 - Formulates and systematizes knowledge, skills and practical skills, including in a foreign language in the areas of higher mathematics, fundamental and applied physics, various methods, technologies and teaching techniques, modern information technologies and software in their future professional activities.

Learning Outcomes in Course (LOC):

LOC 1 - Knows the properties of the basic elementary functions of a complex variable; the principles of conformal mapping, the continuation of functional relations with the real axis; the concept of functions of many complex variables

LOC 2 - Can work with curves (contours); solve algebraic equations with complex numbers; work with elementary functions of complex variables; calculate contour integrals using the Cauchy formula; calculate

deductions by special methods; calculate integrals, including improper ones, from functions of a special kind (rational, trigonometric, power);

LOC 3 - owns various methods of calculating integrals from complex functions and improper integrals; methods of solving linear differential equations by methods of operational calculus; conformal mapping apparatus; the pass method.

Post requisites: Workshop on solving physical problems of increased complexity

Optional component 3

Course: **Solid State Physics**
Intensity of the Course: 5 academic credits
Module Code: SThPh – 8
Module Name: Sections of theoretical physics
Prerequisites: Mechanics, Molecular physics and thermodynamics

Purpose: Subject "physics of solids" to show the features of crystal structures by studying their properties and the physical laws of the crystal lattice; to master the basic physical concepts, quantities and their mathematical expressions and units of measurement. The theory of crystal physics as a result of the achievements of science at the present stage, the results of various observations and experiments and experiments performed.

Short description: The discipline determines the properties of solids using the laws of particles and symmetry. The discipline studies the structure of bodies, the study of the atomic-electronic structure of crystalline materials, the relationship between their composition, structure and various physical properties.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

LO 8 - Conduct scientific research of physical objects, systems and processes, various workshops and experiments, including virtual ones in theoretical and experimental physics using modern instrumentation;

Learning Outcomes in Course (LOC):

LOC 1-The basis of solid state physics and the theory of the crystal lattice and gives its main sections, the history of its development and data related to the theory of modeling.;

LOC 2-understands the composition and structure of modern technology, knowing the model structure of solids;

LOC 3-gets the opportunity to quickly master modern technologies, forms skills to work with them;

LOC 4-conditional writing of mathematical expressions of physics phenomena, understanding the physics of phenomena in it, mastering the principles of work.

Post requisites: Fundamentals of Materials science and Nanotechnology

Optional component 3

Course: **Methods of mathematical physics**
Intensity of the Course: 5 academic credits
Module Code: SThPh – 8
Module Name: Sections of theoretical physics
Prerequisites: Mathematical analysis and analytical geometry

Purpose: to introduce students to the basic concepts of system software and the possibilities of using them to create individual components of the system.

Short description: The concept of methods of mathematical physics includes mathematical methods, special functions used to construct and study mathematical models that characterize large classes of physical phenomena. Limit problems, hyperbolic equations. parabolic type equations. ellipse-type equations. Helmholtz equation, teaches to solve hyperbolic and parabolic equations of the Helmholtz equation type, to determine the elements of the theory of generalized functions.

Learning Outcomes in EP (LOP):

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;

LO 9 - Formulates and systematizes knowledge, skills and practical skills, including in a foreign language in the areas of higher mathematics, fundamental and applied physics, various methods, technologies and teaching techniques, modern information technologies and software in their future professional activities

Learning Outcomes in Course (LOC):

LOC 1 - knows the composition, organization and principles of operation of the main components of the software;

LOC 2 – has various knowledge and concepts of physical and software organization of data input and output;

LOC 3 – evaluates and uses the capabilities of operating systems, file systems, programming automation systems;

Post requisites: Workshop on solving physical problems of increased complexity

Optional component 4

Course: **Atomic physics**

Intensity of the Course: 5 academic credits

Module Code: GPh-6

Module Name: General Physics

Prerequisites: Mechanics, Molecular physics and thermodynamics

Purpose: Formation of knowledge and qualification skills of the future physicist through knowledge of the structure of the atom; generalization of formulas and training in their application in everyday practice..

Short description: The discipline studies physical phenomena characterized by cyclic changes in physical quantities in time and space. Students can consider mechanical and electromagnetic processes and understand the theory of vibrations and waves based on kinematics and dynamics.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 8 - Conduct scientific research of physical objects, systems and processes, various workshops and experiments, including virtual ones in theoretical and experimental physics using modern instrumentation;

Learning Outcomes in Course (LOC):

LOC 1 - knowledge of atomic physics is formed, they can put into practice the knowledge gained on the topics of Bohr's postulates, Rutherford's experiments, etc.; students learn the basic principles and laws of atomic physics, mathematical skills are formed;

LOC 2 - masters new technologies in atomic physics; has innovative, search, cultural, educated, business training.

LOC 3 - students solve problems, master basic physical concepts, quantities and their mathematical expressions and units of measurement; can apply systematized theoretical and practical knowledge of various sciences

Post requisites: Nuclear physics

Optional component 4

Discipline: **The beginnings of modern physics**

Intensity of the Course: 5 academic credits

Module Code: GPh-6

Module Name: General Physics

Prerequisites: general physics course

Purpose: The improvement of knowledge through the disclosure of the importance of cognitive practice, the structural description of matter and its unity, the versatility of fundamental conservation laws, the dialectical characterization of physical phenomena, the logic of physical theory, the problems of the relationship between theory and practice for the development of physics.

Short Description: The discipline studies concepts, laws, theories, methods and means of modern physics as the main components of scientific and technological progress. Modern physics studies achievements in economics and problems (global environmental and energy).

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 8 - Conduct scientific research of physical objects, systems and processes, various workshops and experiments, including virtual ones in theoretical and experimental physics using modern instrumentation;

Learning Outcomes in Course (LOC):

LOC 1-understands the fundamental laws of physics and the role of the most important areas of development of modern scientific branches.

LOC 2-learn how to conduct a scientific and methodological analysis of the physical characteristics of systems and give them a physical interpretation.

LOC 3-develops new relevant scientific directions and the main achievements of physics and their application in science and technology.

Post requisites: Introduction to elementary particle physics

Optional component 5

Course: **Nuclear physics**

Intensity of the Course: 6 academic credits

Module Code: GPh-6

Module Name: General physics

Prerequisites: Atomic physics

Purpose: the formation of a student's holistic system of knowledge on the basics of modern nuclear physics, basic quantum concepts, the development of skills for constructing quantum mechanical models and solving physical problems.

Short Description: In this course, students consider the structure and properties of atomic nuclei and their collision. Also, during the course, alpha -, beta-and gamma-decays, quantum numbers, laws of symmetry and conservation, nuclear isotopes and decay laws, nuclear and thermonuclear reactors will be studied.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 8 - Conduct scientific research of physical objects, systems and processes, various workshops and experiments, including virtual ones in theoretical and experimental physics using modern instrumentation;

Learning Outcomes in Course (LOC):

LOC 1 - analyzes the classification of computer games;

LOC 2-knows the types and methods of programming computer games;

LOC 3-knows how to use computer games.

Post requisites: Quantum mechanics

Optional component 5

Discipline: **Introduction to elementary particle physics**

Intensity of the Course: 6 academic credits

Module Code: GPh-6

Module Name: General physics

Prerequisites: Beginnings of modern physics

Purpose: to acquaint students with elementary particle physics in the form that it has taken at the present time due to the rapid development of theory and experiment that has taken place over the past fifty years.

Short description: In the discipline, students will gain knowledge on the introductory part of elementary particle physics, that is, on the physics of elementary particles involved in electromagnetic, weak and strong interactions: quarks, leptons and neutrinos. They will gain skills in calculating their energies, interactions, their mechanisms, statistics, transformations, charges, spins, and other characteristics. And apply this knowledge and skills when studying the physical foundations of various types of electronics.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

Learning Outcomes in Course (LOC):

LOC 1 - forms students' professional competencies related to the use of modern theoretical concepts in the field of elementary particle physics;

LOC 2 - develops the ability to interpret the data of physical experiments and compare them with theoretical conclusions;

LOC 3 - students acquire the skills of independent research work involving the study of specific algorithms, tools and tools necessary to solve problems of elementary particle physics;

LOC 4 - develop and investigate models of elementary particle physics..

Post requisites: Theory of electromagnetic radiation

3. CYCLE OF MAJOR COURSES

Optional component 1

Discipline: **Laboratory workshop in physics**

Intensity of the Course: 5 academic credits

Module Code: PhWSS – 7

Module Name: Physical workshop and special sections

Prerequisites: general physics course

Purpose: The importance of the physical laboratory at school, its essence and types. Methods of the physical laboratory at school and the methodology of its implementation, their difference and interrelation to use modern information technologies for analysis and processing in accordance with the results of a laboratory workshop in physics.

Short description: The meaning of a school physical experiment, its meaning and types. Technique of school physical experiment and methods of its implementation, their difference and relationship. General (main) equipment of the school physics room. Techniques and methods for conducting demonstration experiments in physics. Techniques and methods of conducting frontal laboratory work. A set of standard laboratory equipment for a school laboratory. Technology of laboratory work. Technique and methodology for conducting the physical work in the workshop. Using a physical experiment to activate students ' cognitive activity.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

LO 8 - Conduct scientific research of physical objects, systems and processes, various workshops and experiments, including virtual ones in theoretical and experimental physics using modern instrumentation;

Learning Outcomes in Course (LOC):

LOC 1- knows the laboratory workshop in physics, its essence and types. Physical Laboratory equipment at school and methods of its implementation;

LOC 2 - reveals the possibilities of a physical experiment for the development of cognitive activity of students;

LOC 3 - technique and methodology of conducting demonstration experiments in physics;

LOC 4 - formation of students' skills in the development and development of experimental methods and techniques;

LOC 5 - acquaintance with the prospects for the development of techniques and methods of physical experiment at school with the use of new technologies in educational experiment;

LOC 6 - processes, analyzes and presents data of analytical and quantitative calculations, experimental data, including in a foreign language, with the help of modern technical means and computer technologies, experimental research, measuring and analytical and technological equipment;

LOC 7 - with the help of a modern instrument base, conducts scientific research, various workshops and experiments, including virtual ones, from theoretical and experimental physics to physical objects, systems and processes.

Post requisites: Workshop on solving physical problems of increased complexity

Optional component 1

Discipline: **Physical experiment methods**
Intensity of the Course: 5 academic credits
Module Code: PhWSS – 7
Module Name: Physical workshop and special sections
Prerequisites: general physics course
Purpose: Use modern information technologies for conducting, analyzing and processing the results of a physical experiment.
Short description: The discipline forms students for their future professional activity the skills of methodically correct organization, conducting a physical experiment, measuring physical quantities, processing the results of the experiment, their correct analysis, as well as methods of effective organization of the selection of physical devices and equipment (assembly of devices, homemade devices, etc.). Thus, within the framework of the updated school physics course, students realized the practical application of theoretical knowledge, solving various real problems, which require creative and critical thinking, develop the necessary competencies for further professional activity.
Learning Outcomes in EP (LOP):
LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;
LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;
LO 8 - Conduct scientific research of physical objects, systems and processes, various workshops and experiments, including virtual ones in theoretical and experimental physics using modern instrumentation;
Learning Outcomes in Course (LOC):
LOC 1-methods of physical experiment. Discipline methodically correct organization of a physical experiment for the future professional activity of students, measurement of physical quantities, processing of experimental results
LOC 2-systematization of knowledge about the types of experiment, the essence of the technique and the methodology of the experiment (their difference and relationship).
LOC 3-to reveal the possibilities of a physical experiment for the development of cognitive activity of students.
LOC 4-has fundamental knowledge, practical skills and abilities in the field of general, theoretical and modern physics.
LOC 5-formation of students' skills in the development and development of experimental methods and techniques.
LOC 6-acquaintance with the prospects for the development of techniques and methods of physical experiment at school using new technologies in educational experiment
Post requisites: no

Optional component 2

Course: **Electrodynamics and SRT**
Intensity of the Course: 5 academic credits
Module Code: SThPh – 8
Module Name: Sections of theoretical physics
Prerequisites: Electricity and magnetism
Purpose: To form students' modern physical and scientific worldview. To form students' knowledge and skills of using fundamental laws, theories of classical and modern physics, as well as skills of conducting physical research as a basis for future professional activity.
Short Description: The structure of matter and the laws of nature introduce students, form the use of methods of physical science and special physical theories. Demonstrates the application of methods of methodical generalization of theoretical physics using the basic methods of physical concepts and principles, their connection with modern science and technology. Special relativity theory the study of the fundamentals of relativistic mechanics and electrodynamics helps to better understand the relationship between the classical and relativistic concepts. On the other hand, it allows us to use the relativistic concept to explain electrodynamics.
Learning Outcomes in EP (LOP):
LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

Learning Outcomes in Course (LOC):

LOC 1 - to reveal the essence of the basic concepts, laws, theories of classical and modern physics in their internal connection and integrity.

LOC 2 - the physical content and meaning of the main provisions, laws, laws and a brief description of the topic and the studied sections of electrodynamics;

LOC 3 - statistical methods of processing experimental data obtained in an experiment using a computer under conditions of large computations;

LOC 4 - determination of the goal, solution of the problem, formation of a hypothesis about possible ways to solve the problem, selection of the procedure for collecting and processing the necessary data, collection, processing and analysis of the results;

LOC 5 - conducting qualitative and quantitative research on the profile of the specialty with the help of modern physical scientific equipment;

LOC 6 - correct interpretation of the information received to make optimal decisions taking into account specific situations;

LOC 7 – correlate the solution of problems arising in practice with the physical nature of the phenomena under consideration and find the correct physical interpretation.

Post requisites: no

Optional component 2

Discipline: **Applied electrodynamics**

Intensity of the Course: 5 academic credits

Module Code: SThPh – 8

Module Name: Sections of theoretical physics

Prerequisites: Electricity and magnetism

Purpose: To study the connection of electric and magnetic phenomena, electromagnetic radiation, electric current and its interaction with the electromagnetic field.

Short description: The course studies various fundamental and applied aspects of electrodynamics. Both theoretical and applied problems will be solved, and their application will be studied for analysis and modeling of processes in electrical and electric power devices, such as transformers, electric motors, etc.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

Learning Outcomes in Course (LOC):

LOC 1 - knows the connection of electrical and magnetic phenomena;

LOC 2 - knows electromagnetic radiation, electric current and its interaction with the electromagnetic field

Post requisites: no

Optional component 3

Course: **Static physics and thermodynamics**

Intensity of the Course: 6 academic credits

Module Code: SThPh – 8

Module Name: Sections of theoretical physics

Prerequisites: Molecular physics and thermodynamics

Purpose: formation of students' modern ideas about the basic methods of statistical and thermodynamic description of the properties of equilibrium and nonequilibrium macroscopic systems consisting of a large number of particles.

Short Description: Teaching students to use this knowledge in applied issues, as well as deep and solid knowledge of the basic thermodynamic and statistical knowledge of macroscopic systems. Teaches to pay special attention to various methods characteristic of thermodynamic and statistical theories when solving tasks. Students should know the basic concepts and fundamentals of thermodynamics and statistical physics, be able to set problems

solved in thermodynamics and statistical physics, study solution methods, find numerical values of parameters of each individual physical system obtained by the system of Gaustyk and international units.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

Learning Outcomes in Course (LOC):

LOC 1 - To know the fundamental principles (principles) and methods of thermodynamics for studying the properties of macrosystems in a state of thermodynamic equilibrium;

LOC 2 - to know the basic concepts and provisions of statistical physics; to know the basic distributions of S.F.;

LOC 3 - to know the modern aspects of the application of statistical physics as a method for studying the structure of matter.

LOC 4 - Be able to apply the basic laws of thermodynamics to determine the thermal properties of macrosystems;

LOC 5 – be able to apply the basic concepts of statistical physics to calculate the thermodynamic characteristics of simple macrosystems.

LOC 6 - Possess the skills of calculating the macroparameters of the system using the method of cycles and the method of characteristic functions;

LOC 7 - have the skills to calculate the macroparameters of the system using the Gibbs statistical ensemble and the phase cell method.

Post requisites: Selected Chapters in Theoretical Physics

Optional component 3

Discipline: **Fundamentals of kinetic theory**

Intensity of the Course: 6 academic credits

Module Code: SThPh – 8

Module Name: Sections of theoretical physics

Prerequisites: Molecular physics and thermodynamics

Purpose: formation of students' modern ideas about the structure of matter, to establish the laws of behavior of macroscopic systems and irreversible processes in thermodynamic systems.

Short description: Irreversible processes in thermodynamic systems. Statistical method. Stages of development of the kinetic theory. Nonequilibrium properties of molecular systems. Features of transfer processes in a wide range of macroparameters. Elementary kinetic theory of transport processes in gases. Kinetic equations. Boltzmann equation. Cluster model of gases. Cluster model of processes in gas mixtures.

Learning Outcomes in EP (LOP):

LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;

LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;

LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;

Learning Outcomes in Course (LOC):

LOC 1 - to know the nature of thermal phenomena in macroscopic bodies and the properties of these bodies, the main provisions of the MCT;

LOC 2 - to know the basic concepts and methods of solving MKT problems;

LOC 3 - to know the basics of thermodynamics, the application of the laws of molecular physics.

Post requisites: no

Optional component 4

Course: **Quantum mechanics**
Intensity of the Course: 6 academic credits
Module Code: SThPh – 8
Module Name: Sections of theoretical physics
Prerequisites: Nuclear physics
Purpose: quantum field theory describing the laws of motion and interaction of microparticles taking into account fields, gravitational, electromagnetic.
Short Description: The course is aimed at the formation of quantum-mechanical concepts of micro-objects.The course, which is one of the main directions of the development of modern physics, studies the processes of the microcosm at microscopic scales and the properties of microparticles, the laws of their motion and interaction based on the concepts of the discreteness of quantum quantities, the wave nature and the probabilistic (statistical) method of describing objects.
Learning Outcomes in EP (LOP):
LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;
LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;
Learning Outcomes in Course (LOC):
LOC 1 – be able to describe with the help of operators the basic properties of quantum, gravitational, electromagnetic fields.
LOC 2 - to carry out the selection and use of optimal research methods.
LOC 3 - the technology of describing quantum phenomena and the method of applying them in practice.
Post requisites: Fundamentals of Materials science and Nanotechnology

Optional component 4

Course: **Theory of electromagnetic radiation**
Intensity of the Course: 6 academic credits
Module Code: SThPh – 8
Module Name: Sections of theoretical physics
Prerequisites: Introduction to elementary particle physics
Purpose: The study of the propagation of electromagnetic waves, the time dependences of electric fields, the determining type of waves, the type of polarization and other features depend on the radiation source and the properties of the medium, taking into account their quantum nature.
Short Description: In the discipline, students will study the optical and wave components of electromagnetic radiation, their practical application in the design of instruments and devices that detect and use electromagnetic radiation, as well as the practical application of the wave and optical nature of light in various technologies and everyday objects, including mirrors, lenses, telescopes, microscopes, lasers and fiber optics.
Learning Outcomes in EP (LOP):
LO 4 - Owns fundamental knowledge, practical skills and abilities in the fields of general, theoretical and modern physics;
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 7 - Processes, analyzes and presents, including in a foreign language, data of analytical and numerical calculations, experimental data using experimental research, measuring and analytical and technological equipment of modern technical means and computer technologies;
Learning Outcomes in Course (LOC):
LOC 1 - knows the practical application of devices and devices that detect and use electromagnetic radiation;
LOC 2 - finds solutions to problems of determining the wave and optical nature of light in various technologies and everyday objects;
LOC 3 - owns the practical application of electromagnetic radiation in mirrors, lenses, telescopes, microscopes, lasers and fiber optics.
Post requisites: no.

Optional component 5

Discipline: **Workshop on solving physical problems of increased complexit**
Intensity of the Course: 6 academic credits
Module Code: PhWSS – 7
Module Name: Physical workshop and special sections
Prerequisites: Laboratory workshop in physics
Purpose: Training of specialists with high professional competence who are able to effectively use the theoretical knowledge obtained from the physics course in solving practical problems.
Short description: Introduction to the methodology for solving complex problems in physics. Algorithmic and heuristic methods of solution. Recommendations on the use of the mathematical apparatus. Calculation methods for solving problems in physics. The physical model of the phenomenon under consideration. Methodological principles for solving problems. The principle of symmetry and analogy in physics in solving physical problems. The principle of relativity. Methodology for solving experimental problems. Solving the problems of the Olympiad in the subject.
Learning Outcomes in EP (LOP):
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;
Learning Outcomes in Course (LOC):
LOC 1 - the use of various problem solving technologies, including mathematical methods and methods;
LOC 2 - forms of organization of students' academic work in solving problems in physics;
LOC 3 - identify and calculate experimental and computational errors;
LOC 4 - competent use of physical and mathematical scientific languages.
Post requisites: no.

Optional component 5

Discipline: **Theory and methodology of solving physical problems**
Intensity of the Course: 6 academic credits
Module Code: PhWSS – 7
Module Name: Physical workshop and special sections
Prerequisites: Physical experiment methods
Purpose: The study of the theory and methodology of solving physical problems, the formation of students' high professional competence, the ability to solve problems, the effective use of theoretical knowledge to solve physical problems.
Short description: The course examines the importance of problem solving in physics and its role in the educational process, psychological features of solving physical problems and didactic analysis of the process of solving physical problems, ways and methods of solving problems. The mathematical apparatus used for solving problems, the algorithm for solving physical problems, the algorithm for solving physical problems, the method for solving qualitative problems, experimental problems, test tasks, and graphical problems are considered.
Learning Outcomes in EP (LOP):
LO 5 - Solves problems of theoretical, experimental and numerical nature using knowledge from fundamental and applied physics, using the appropriate mathematical apparatus, numerical methods, computer modeling, modern software;
LO 6 - Builds physical, mathematical and computer models of typical professional tasks using modern software and interprets the results obtained taking into account the limits of applicability of the models;
Learning Outcomes in Course (LOC):
LOC 1 - methods for solving physical problems, including using mathematical methods;
LOC 2 - forms of organization of experimental work in solving problems in physics;
LOC 3 - competent use of physical and mathematical scientific languages.
Post requisites: no.