CATALOG OF ELECTIVE DISCIPLINES

6B05 - Natural Sciences, Mathematics and Statistics
(Code and classification of the field of education)

6B053 - Physical and chemical sciences
(Code and classification of the direction of training)

0530
(Code in the International Standard Classification of Education)

B054 - Physics
(Code and classification of the educational program group)

6B05303 - Technical physics
(Code and name of the educational program)

Bachelor
(Level of preparation)

set of 2023

Семей 2023

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Chairman of the Academic Council Oralkanova Indira

Introduction to Specialty

Discipline cycle	Basic disciplines
Course	1
Credits count	3
Knowledge control form	Examination

Short description of discipline
The discipline "Introduction to specialty" introduces students to the basics of obtaining artificial cold, and its use in various industries, and with the development of refrigeration technology, as well as with the field of application of nuclear energy, the structure of the nuclear industry of the Republic of Kazakhstan. Physical methods of obtaining electrical and thermal energy. Nuclear fuel and coolants. The role of foreign and domestic scientists in the development of nuclear energy.

Purpose of studying of the discipline
Acquaintance of students with the physical foundations of obtaining artificial cold, its use in various industries, as well as with the use of nuclear energy.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.

Learning outcomes by discipline
1) Know the area, objects and types of professional capacity; achievements of domestic and foreign science and technolo-gy in the field of technical physics.
2) Able to use abstracts, periodicals and reference edition on the profile of the work.
3) Has the ability to use special litera-ture and other scientific and technical information.

Prerequisites
School course

Postrequisites
Nuclear research reactors Refrigerators

History of the development of energy

Discipline cycle	Basic disciplines
Course	1
Credits count	3
Knowledge control form	Examination

Short description of discipline
The discipline "History of the development of energy" forms knowledge on the history of the development of science and technology in the field of energy. Methodological foundations of the history of the development of science and technology, the creation of a steam turbine, the invention of a steam engine, historical and technical prerequisites for the emergence of qualitatively new technical objects, the cycles of steam power plants, internal combustion engines, gas turbine plants, jet and rocket engines, nuclear heat and power plants, refrigeration plants.

Purpose of studying of the discipline
The development of theoretical and practical knowledge by students and the acquisition of skills and abilities in the field of energy, as well as the formation of stu-dents` knowledge and skills as part of their professional training.

Learning Outcomes
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Knows the basic laws of the historical process of the power system; global environmental problems.
2) Able to independently analyze the socio-political and scientific literature.
3) Has writing skills to present an ar-guable own point of view.

Prerequisites
School course

Postrequisites
Nuclear research reactors Refrigerators

Basics of Alternative Energy

Discipline cycle	Basic disciplines
Course	1
Credits count	3
Knowledge control form	Examination

Short description of discipline
The discipline " Basics of Alternative Energy
" forms the general principles of the foundations of non- traditional energy in solving problems of energy use in heat engineering production. Within the framework of environmental problems of energy and the dynamics of consumption of energy resources, energy sources and the development of the energy sector. Place non-traditional energy needs of non-traditional energy sources. geothermal energy. Solar energy installations. Physical bases of processes of transformation of solar and wind energy.

Purpose of studying of the discipline
Familiarization of students with the technology of energy production based on non-traditional energy.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Knows the status, problems and future directions.
2) Able to analyze the energy bal-ances of industrial enterprises that use al-ternative energy sources; evaluate the ef-fectiveness of the use of non-traditional energy industries.
3) Has the ability to use calculation methods in the field of alternative energy.

Prerequisites

School course

Postrequisites

Nuclear research reactors Refrigerators

Computer technologies in the energy sector

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Computer technologies in the energy sector" forms students` knowledge in the field of using computer technology in the calculations of heat and power processes.
Excel spreadsheet processors, mathematical packages MathCAD, DBMS, information systems. Application of methods for solving linear systems in thermal engineering calculations, transcendental, nonlinear, stationary and non- stationary equations of heat conduction. Construction of models of thermal power facilities. Application of finite difference methods to the equations of convective heat transfer.

Purpose of studying of the discipline

The main goal of this course is the formation of students` knowledge, skills and abilities to use modern automated projects in energy processes.

Learning Outcomes

ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Knows how to use the Metodd finite difference equations in the solution of convective heat-tions; general methods of interpolation and approximation, is-polzuemye-in processing experimental data.
2) Umeetpolzovatsya mathematically of application packages; nastrai vat AutoCAD system under a particular subject area.
3) Has skills means and techniques of working with the editor of a mathematical system MathCAD; working with a graphical editor of AutoCAD.

Prerequisites

Application of USDD standards in the design of engineering documentation.

Postrequisites

Final examination Bases for design and construction of refrigerating machines with elements of CAD Controlled thermonuclear fusion

Elements of computer graphics in technical physics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Elements of computer graphics in technical physics" studies the use of modern computer-aided design systems. Effective use of graphic editors. Color palette. Features and settings for CorelDraw, AutoCAD and Visio. Work with graphics and text. Basic concepts of three-dimensional graphics. Graphic data formats. Features of setting parameters and studying the interface and setting parameters of vector graphics editors.

Purpose of studying of the discipline

Formation of students` knowledge, skills and abilities to use elements of computer graphics.

Learning Outcomes

ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

Learning outcomes by discipline

1) Know the requirements for a formal statement of the unit and the main tasks of the divisions of computer graphics; capabilities and applications of AutoCAD.
2) Knows how to use a computer with at-building or upgrading of algorithms in the structure and realistic tone IMAGE-tions.
3) Has skills means and techniques of working with the graphic editor of AutoCAD.

Prerequisites

Application of USDD standards in the design of engineering documentation.

Postrequisites

Final examination Bases for design and construction of refrigerating machines with elements of CAD Controlled thermonuclear fusion

Elements of computer graphics and CAD bases in technical physics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline " Elements of computer graphics and CAD bases in technical physics " forms the student`s use of computer technology in heat technology. General information about application software, mathematical packages, MathCAD system. Computer graphics, basic representations of graphic data and their formats. Features of AutoCAD, setting parameters, working with graphics, text, studying the interface and setting parameters of the vector graphics editor AutoCAD.

Purpose of studying of the discipline
Formation of the student`s knowledge, skills and abilities in the field of using modern computer-aided design systems in technical physics.

Learning Outcomes
ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

Learning outcomes by discipline
1) explains the requirements for setting the main tasks for the sections of computer graphics;
2) uses the tools and techniques of working with the graphic editor of the AutoCAD system;
3) solves problems by means and methods of working with the mathematical editor of the MathCAD system.

Prerequisites
Application of USDD standards in the design of engineering documentation.

Postrequisites
Final examination Bases for design and construction of refrigerating machines with elements of CAD Controlled thermonuclear fusion

Theoretical basics of heat engineering

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline " Theoretical basics of heat engineering " studies: the most rational ways of using heat, analysis of the efficiency of the working processes of thermal installations, to create new most advanced types of thermal units with the skillful combination of these processes. Without this, it would be impossible to create powerful steam and gas turbine plants, jet engines and other types of complex thermal installations. There are two fundamentally different uses of heat: energy; technological.

Purpose of studying of the discipline
Theoretical and practical training of future specialists in the methods of obtaining, transforming, transferring and using heat to such an extent that they could select and, if necessary, exploit the necessary thermal engineering equipment of the na-tional economy sectors in order to maxim-ize the economy of fuel and energy re-sources and materials, intensify and opti-mize technological processes, and identify secondary energy.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline
1) calculate forward and reverse cycles, Carnot cycle;
2) apply the basic provisions and laws of thermodynamics for the analysis of physical and chemical processes;
3) carry out calculations of thermal efficiency of cycles

Prerequisites
Physics

Postrequisites
Heat and Mass Transfer Energyequipment NEI Air conditioning and ventilation

Heat engineering

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline " Heat engineering " studies the basic laws of heat and mass transfer of thermal and caloric properties of substances of the interconversion of energy, heat and work. A science that studies the cycles of heat engines, stationary and non-stationary heat conduction, methods of heat transfer, the differential equation of heat conduction, types and classification of fuel, methods of fuel combustion, as well as methods for obtaining, converting, transferring and using heat, and performing standard heat engineering calculations.

Purpose of studying of the discipline
Students acquire the skills to use the laws of thermodynamics and heat transfer in solving practical problems related to technological thermal processes and the principles of thermal devices.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical

analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline

1) describe phase equilibrium and phase transitions;
2) expound the theory of flow thermodynamics
3) choose tables and diagrams of the state of substances in the analysis of processes and cycles

Prerequisites

Physics

Postrequisites

Heat and Mass Transfer Energyequipment NEI Air conditioning and ventilation

Thermodynamics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Thermodynamics" studies: basic concepts and definitions, ideal gas laws, gas mixtures, the first and second law of thermodynamics, phase transitions and equilibrium of thermodynamic systems, real gases, T-S and h-S-diagrams and thermodynamic tables of the state of matter, thermodynamic processes of water and water steam, humid air h-d diagram, humid air drying processes, throttling, thermal power gas cycles, refrigeration cycles, heat pump cycle.

Purpose of studying of the discipline

training and the application of methods of thermodynamics-ki for the analysis of physical-chemical phenomena of modern methods of analysis and calculation of the thermodynamic processes and cycles.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline

1) explain the thermodynamic properties of pure substances and their mixtures;
2) to determine the thermodynamic properties of pure substances, their mixtures and their changes in thermodynamic processes;
3) calculate the thermal and caloric parameters of the state, heat and work in thermodynamic processes of ideal, real gases;

Prerequisites

Physics

Postrequisites

Heat and Mass Transfer Energyequipment NEI Air conditioning and ventilation

Heat and Mass Transfer

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination and term work/Project

Short description of discipline

The purpose of studying the discipline "Heat and Mass Transfer" is to provide students with extensive knowledge about the fundamental laws, regularities and methods of analysis and calculation of heat and mass transfer processes. In stationary heat conduction. Non-stationary thermal conductivity. Heat transfer by radiation. Convective heat transfer in a homogeneous medium. Forced and natural convection. Similarity of heat transfer phenomena. In heat transfer processes during phase transformations. In the processes of mass transfer and thermal calculation of heat transfer calculations.

Purpose of studying of the discipline

To give students exten-sive knowledge about the fundamental laws, regularities and methods of analysis and calcula-tion of heat and mass transfer processes, to develop practical skills in determining the char-acteristics of heat and mass transfer processes of heat power devices and apparatuses.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline

1) use the basic laws of heat and mass transfer;
2) determine the heat transfer coefficients during natural and forced motions of the liquid, as well as during phase transitions;
3) interpret the equations of heat conduction and the simplest systems of equations for convective heat transfer in a homogeneous medium with constant thermophysical properties under various uniqueness conditions;

Prerequisites

Thermodynamics

Postrequisites

Fundamentals of reactor physics Air conditioning and ventilation

Heat and mass transfer processes and apparatuses thermotehnologi

Discipline cycle	Basic disciplines
Course	2
Credits count	5

Knowledge control form	Examination and term work/Project

Short description of discipline
The purpose of studying the discipline " Heat and mass transfer processes and apparatuses thermotehnology " students gain knowledge in the field of the basics of calculating heat exchangers, heat and mass transfer, and the theory of heat transfer. Methods of similarity and dimensions. Heat and mass transfer in furnaces. Qualitative theory for estimating the heat transfer coefficient for forced and free convection. Heat transfer in drying installations. Heat transfer enhancement methods. Types. Heat exchanger efficiency. Thermal and hydraulic calculation of heat exchangers.

Purpose of studying of the discipline
The acquisition of knowledge by students in the theory of heat transfer, heat and mass transfer, and the basis of calculation of heat exchangers.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline
1) Knows the basic laws of heat and mass transfer processes and quantities character-izing these processes.
2) Able to determine the thermal characteris-tics of substances.
3) Has the skills of thermal calculation of heat exchange equipment.

Prerequisites
Thermodynamics

Postrequisites
Fundamentals of reactor physics Air conditioning and ventilation

Chemical thermodynamics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination and term work/Project

Short description of discipline
The discipline "Chemical thermodynamics" studies the scope of modern methods of analysis and calculation of thermodynamic processes, and cycles of thermodynamic methods and for the analysis of physical and chemical phenomena. as well as chemical balance. chemical potential. Application of the first law of thermodynamics to chemical processes. Phase equilibria. Characteristic functions and thermodynamic potentials. Thermal effects of chemical reactions at V= const and p=const.

Purpose of studying of the discipline
Formation of students` knowledge of the basic laws of chemical thermodynamics and methods for calculating the thermodynamic parameters of chemical-technological processes.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline
1) Knows first and second law of thermodynamics, direct and inverse cycles.
2) Able to be used in the main supply and the laws of thermodynamics to Ana Lisa physical and chemical processes. Use tables and charts state agents when analyzing the processes and the CEC-fishing.
3) Has navykiraboty with diagrams of the energy calculations and calculations of thermodynamic processes and cycles.

Prerequisites
Thermodynamics

Postrequisites
Fundamentals of reactor physics Air conditioning and ventilation

Simulation of the electric

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
In this discipline, the device and principle of operation of electrical machines of direct and alternating current, as well as methods for their calculation are considered. The basic principles and methods of modeling, development and analysis of mathematical models that reflect the static and dynamic properties of electric drives, methods for calculating various DC magnetic circuits are considered. Students learn to develop a functional, logical and technical model of electric drives.

Purpose of studying of the discipline
the study of methods for modeling, design and analysis of mathematical models that reflect the static and dynamic properties of the electrical drives.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

Learning outcomes by discipline
1) Know the methods of analysis, simulation and calculation processes and modes of operation of electromechanical systems,

mathematical models and software for the numerical analysis of the physical processes in the drive.
2) Able to develop and analyze mathematical models of electric drives at the appropriate hierarchical level.
3) Has the skills to use computer equipment to solve the problems of analysis and synthesis of simulated electromechanical systems.

Prerequisites

Physics

Postrequisites

Automation of refrigeration ACS processes NPI

Applied Electronics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

The main properties of semiconductor materials and the processes occurring in the p-n-junction are considered. The device and principle of operation of electronic elements based on the use of a p-n junction, as well as methods for calculating electronic circuits based on these devices, are being studied. The second part of the discipline considers digital elements and devices, ways to minimize logic functions, methods of synthesis and analysis of electronic circuits using digital devices.

Purpose of studying of the discipline

Getting the students Knowing of the physical processes that determine the operating principle, the properties, characteristics and parameters of the various semi-conductor devices, discrete and integrated performance.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

Learning outcomes by discipline

1) Know the principle of operation, properties, basic characteristics and parameters of the time- personal of semiconductor devices, integrated circuit elements, opto-electronic and telecommunications systems.
2) Able to conduct studies of the physical processes in semiconductor devices.
3) Has skills avionics, telecommunications and opto-electronic equipment.

Prerequisites

Physics

Postrequisites

Automation of refrigeration ACS processes NPI

Electrical engineering and electronics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

This course of discipline consists of two sections: electrical engineering and electronics. The study of the discipline is based on the theory and practical application of linear, non- linear electrical circuits of direct and alternating current, electrical signals, electrical devices and measurements, the basics of digital electronics in modern production processes and control systems. Various physical quantities characterizing electromagnetic phenomena are also considered.

Purpose of studying of the discipline

The purpose of mastering the discipline is to study by students the basic patterns of processes occurring in electromagnetic and electronic circuits and methods for determining electrical quantities that characterize these processes, the acquisition of theoretical and practical knowledge on the basics of electrical engineering and electronics, necessary for the successful development of subsequent disciplines of the specialty.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

Learning outcomes by discipline

1) be able to experimentally determine the parameters and characteristics of typical electrical devices and equipment;
2) apply the skills of measuring basic electrical quantities and some non-electrical quantities associated with the profile of engineering activities;
3) use electrical devices, devices and machines, manage them, as well as gain the skills of their effective and safe control.

Prerequisites

Physics

Postrequisites

Automation of refrigeration ACS processes NPI

Applied Optics

Discipline cycle	Basic disciplines
Course	2
Credits count	3

Knowledge control form	Examination

Short description of discipline
The purpose of studying the discipline is to familiarize students with the scale of physical quantities of subatomic physics, methods of their theoretical understanding and experimental observation, and the main physical phenomena occurring in the subatomic microcosm. Optics of the eye, optical systems of a microscope, optics of photographic and opto-electronic and television systems, reproduction and projection optical systems, analysis of computer simulation of optical systems, image quality assessment.

Purpose of studying of the discipline
To familiarize students with the basic physical phenomena in the governing proish-subatomic microcosm, methods of their theoretical understanding and experimental observation, the scale of the physical quantities of subatomic physics.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

Learning outcomes by discipline
1) Know the basic physical phenomena of nuclear physics, their characteristics, methods of observation and experimental research; main methods for determining the properties of atomic and elementary particles, the basic laws and their mathematical expression.
2) Able correctly, qualitatively and quantitatively formulated the main tasks in this section and evaluate the procedure of physical quantities; quality concepts and use the quantum relativistic notions when considering the properties of atomic nuclei and elementary particles.
3) Has skills to solve the simplest theoretical model of tasks; Experimental work skills and analyzing the results.

Prerequisites
Physics

Postrequisites
Final examination Nuclear fuel cycle

Elementaric particle Physics

Discipline cycle	Basic disciplines
Course	2
Credits count	3
Knowledge control form	Examination

Short description of discipline
The discipline " Elementary particle Physics " studies the basic concepts and concepts of quantum field theory. The concept of elementary particles. Quantization of the electromagnetic field. Lagrangian approach in field theory. Real scalar field. Complex scalar field. Amplitudes and transition probabilities. Interaction representation. Mass and spin-helicity. Erlangen program. Broadcast generators. Rotation generators. The first Casimir operator and the rest mass of elementary particles.

Purpose of studying of the discipline
To introduce students SOS mainly notions and concepts quantum-field theory.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) explains the laws of physical processes in the microworld, their features and mathematical expression; to formulate contemporary problems and unresolved issues in nuclear physics and elementary particle physics
2) determines the order of physical quantities; use quantum concepts and relativistic concepts when considering the properties of atomic nuclei and elementary particles
3) solves theoretical typical problems; apply experimental work methods; analyze the results

Prerequisites
Physics

Postrequisites
Final examination Nuclear fuel cycle

Nuclear physics

Discipline cycle	Basic disciplines
Course	2
Credits count	3
Knowledge control form	Examination

Short description of discipline
The purpose of studying the discipline: is the acquisition by students of knowledge, skills and abilities in the field of nuclear physics, and necessary for research, design, technological and production activities. Subject, goals and objectives; their place and significance in modern natural science; conditions and stages of nuclear fission, types of radioactivity and radioactive families, static properties of nuclei, nuclear reactions, interaction of radiation with matter.

Purpose of studying of the discipline
Mastering students with fundamental concepts, laws and theories of nu-clear physics.

Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the basic methods of nuclear physics research; types of nuclear re-shares and their laws; the laws of radiation passing through matter; sources and detectors of nuclear radiation.
2) Knows how to use this Knowing in practice;
3) spending estimates and engineering calculations of the results of nuclear transformations.

Prerequisites

Physics

Postrequisites

Final examination Nuclear fuel cycle

Introduction to Medical Physics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Introduction to Medical Physics" studies and assimilates the devices and operation of medical equipment, understanding of physical laws in biological systems, biomechanics, acoustics, lasers and their application in medicine, the basics of medical electronics, the physical foundations of the use of sound and ultrasound in medicine, the transfer process in biological systems, bioelectrogenesis, electrical and magnetic properties of tissues and the environment, ionizing radiation.

Purpose of studying of the discipline

the assimilation of features of the manifes-tation of physical laws in biological sys-tems, an understanding of the structure and operation of medical equipment.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.

Learning outcomes by discipline

1) applies physical laws to explain the processes occurring in the human body
2) evaluates the primary effects of physical factors on the human body
3) describes how medical equipment works

Prerequisites

Physics

Postrequisites

Applied physics and radiation safety

Neutron transport theory

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline " Neutron transport theory " forms the student`s ideas about the methods of their theoretical understanding and experimental observation and the theoretical foundations of neutron transport. Concepts about neutron gas temperature; scattering law; scattering of neutrons on an immobile nucleus; diffusion of neutrons; neutron slowdown in infinite media; thermalization of neutrons; spatial distribution of moderating neutrons; continuous deceleration model; effective resonance integral

Purpose of studying of the discipline

To form students` systematic knowledge in the field of neutron transport theory.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.

Learning outcomes by discipline

1) Know the main features of the process of diffusion of neutrons; the basic laws of interaction of neutrons with matter and their characteristics; research methods in neutron transport theory and mathematical expression.
2) Umeetrasschityvat parameters determining the neutron diffusion in a pro-space.
3) Has navykikachestvennogo is- use concepts of quantum and relativistic, relativistic concepts when considering the properties of atomic nuclei and elementary particles; the interaction of neutrons with matter.

Prerequisites

Physics

Postrequisites

Applied physics and radiation safety

The nuclear and neutron physics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The purpose of studying the discipline
acquiring skills in processes in nuclear and thermonuclear reactors and solving problems for various processes and studying the elements of quantum mechanics, the proton-neutron model of the nucleus, neutron binding energies, nuclear forces, radioactive nuclei, energy schemes of a nuclear reaction, neutron physics, neutron source reactor, basic patterns of interaction of neutrons with nuclei in various energy regions, the spectrum of thermal neutrons.

Purpose of studying of the discipline
Mastering by students of fundamental knowledge in the field of neutron and nuclear physics, as well as areas of their practical application.

Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Knows nuclear and neutron-physical processes taking place in the nuclear and thermonuclear reactors.
2) Able to analyze the dependence of the interaction cross sections of neutrons in a one-personal energy areas for personal time-nuclides.
3) Has skills of calculations for various nuclear reactions.

Prerequisites
Physics

Postrequisites
Applied physics and radiation safety

Molecular Physics and Thermodynamics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Molecular Physics and Thermodynamics" contains: three principles of thermodynamics, the basic equation of state of an ideal gas, heat engines and their efficiency, transfer phenomena (diffusion, thermal conductivity, internal friction), isoprocesses, gases, liquids and solids, their changes as a result of external influences (pressure, temperature, electric and magnetic fields), phase equilibrium and transient processes (crystallization and melting, evaporation and condensation).

Purpose of studying of the discipline
Formation of students` professional competencies related to the use of fundamental concepts, as well as modern concepts in the field of thermodynamics and molecular physics.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.

Learning outcomes by discipline
1) basic physical theories and prin-ciples, physical research methods, basic laws and limits of their applicability;
2) apply theoretical knowledge to solve specific physical problems and situa-tions, analyze the results of a physical ex-periment, simulate physical situations us-ing a computer; conduct physical experi-ments, work with measuring devices;
3) the physical and ideological inter- pretation of classical and modern physics; restructure your thinking to the perception of the inevitable transformations of scien-tific and technical ideas into fundamentally new ones

Prerequisites
Thermodynamics

Postrequisites
Final examination

Applied Thermal Physics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
Discipline "Applied Thermal Physics" studies: Quantum statistics and their application in the foundations of molecular kinetic theory. Thermal processes in gases. Thermodynamic reversible and irreversible processes. In the study of physical phenomena, the development of techniques and skills for conducting experimental and scientific experiments. When solving specific technological and practical applications that set as their goal physical problems, a complex of scientific disciplines and sections of physics directions are studied.

Purpose of studying of the discipline
Formation of students `skills and abilities to use fundamental laws, theories of classical and modern physics, as well as methods of physical research to solve theoretical and experimental-practical learning tasks from various fields of physics, the formation of students` skills in independent cognitive activity, the development of techniques and skills experimental scientific studies of physical phenomena that help to further solve specific problems in professional ac-tivity.
Learning Outcomes
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
Learning outcomes by discipline
1) basic physical theories and prin-ciples, physical research methods, the basic laws and limits of their applicability;
2) apply theoretical knowledge to solve specific physical problems and situations, analyze the results of a physical experiment, simulate physical situations using a computer;
3) to rebuild thinking to perceive the inevitable transformations of scientific and technical ideas into fundamentally new ones.
Prerequisites
Thermodynamics
Postrequisites
Final examination

Statistical physics and thermodynamics

Discipline cycle	Basic disciplines
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Statistical Physics and Thermodynamics" contains: all the principles of thermodynamics, temperature and entropy, when microcanonical, canonical or greater canonical distributions can be applied, quantum distributions of Fermi-Dirac, Bose-Einstein and Planck as well as classical distributions of Maxwell and Boltzmann, the probabilistic approach lies not in the nature of things, as in quantum theory, but is connected with the impossibility of a detailed description of systems.
Purpose of studying of the discipline
The purpose of this course is to familiarize students with the basic concepts and prin-ciples of statistical physics and thermody-namics.
Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
Learning outcomes by discipline
1) shows that the probabilistic approach is associated with the inability to describe systems in detail;
2) demonstrates application of microcanonical, canonical, and or greater canonical distribution;
3) explains special cases: classical distributions of Maxwell and Boltzmann, quantum distributions of Fermi-Dirac, Bose-Einstein and Planck
Prerequisites
Thermodynamics
Postrequisites
Final examination

Air conditioning and ventilation

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Air conditioning and ventilation" studies air purification devices, air distribution systems, calculation and selection of air ducts, fans, calculation of system performance, microclimate, heat and humidity balances of air-conditioned rooms, heat exchangers for heat and moisture treatment of air, devices for contact type heat and moisture treatment of air, and to control the amount of air, the main parameters of air, air conditioning systems, processing processes.
Purpose of studying of the discipline
The study of student basic and fundamental tenets of the theory and practical calculations of modern air conditioning systems, taking into account the relationship of air conditioning systems and cooling systems.
Learning Outcomes
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
Learning outcomes by discipline
1) explains the main principles of air conditioning theory as a basis for making correct, reasonable and cost-effective technical decisions
2) determines the parameters of the state of moist air; calculate humid air processes; build air handling processes in i-d diagram

3) uses methods to determine the optimal parameters of air conditioning systems

Prerequisites

Physics Fluid Dynamics Thermodynamics Heat and Mass Transfer

Postrequisites

Basic and profile disciplines of the EP Final examination Refrigerators Heat pumps

Energyequipment NEI

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination and term work/Project

Short description of discipline

The purpose of studying the discipline " Energy equipment NEI " of devices and elements of nuclear power plants, as well as the characteristics of technological schemes of nuclear power plants, thermal schemes of nuclear power plants, power cycles of plants and efficiency factors, steam and gas turbines, pumps and gas blowers, working fluids and coolants , heat exchangers and steam generators, structural diagrams and optimization of equipment parameters.

Purpose of studying of the discipline

Formation of basic information on the purpose, composition and principles of operation of the main power equipment of nuclear power plants.

Learning Outcomes

ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the characteristics of technology-cal schemes NPP; modes Naib-Lee important mechanisms of own needs and require-ments to their reliability; steam and gas turbines, pumps and blowers; steam gener-ators and heat exchangers.

2) Able to calculate the steam and gas tur-bines; carry out thermal calculations of steam generators.

3) Has skills in calculation of power of mod-ern nuclear power plants (NPP).

Prerequisites

Physics Thermodynamics Heat and Mass Transfer Elementaric particle Physics

Postrequisites

Basic and profile disciplines of the EP Final examination

Alternative and renewable energy sources

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline " Alternative and renewable energy sources " studies: to satisfy a person in the needs of energy from non-traditional sources. Wind power installations. Physical bases of processes of transformation of solar energy at use of energy of the Sun. The use of agricultural and industrial waste, and the possibility of their use as primary sources for the production of heat and electricity. Geothermal energy, thermal regime of the earth`s crust.

Purpose of studying of the discipline

Formation of general principles for the use of non-traditional and renewable energy sources in solving problems of energy use in heat engineering production.

Learning Outcomes

ON2 Apply laws and regulations in the field of economics and law, ecology and life safety, as well as the skills of entrepreneurship, leadership, and receptivity of innovations.

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Able to analyze the energy balances of industrial enterprises that use renewable energy;

2) evaluate the effects of the use of renewable energy in the national economy;

3) Develop issues incorporated by the use of renewable energy resources.

Prerequisites

Physics History of the development of energy Basics of Alternative Energy

Postrequisites

Basic and profile disciplines of the EP Final examination Basics of Heat Transformation Heat and mass transfer in power plants Heat pumps

Chillers

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline " Chillers " studies the theory of refrigeration machines and the design of their elements in general and work processes.

Properties of working substances of low-temperature systems. Cycles of gas refrigeration machines, absorption, vapor compression, and heat pumps. Operating characteristics of compressors; dynamics of reciprocating machines. Methods of thermal and gas- dynamic calculation of the main types of apparatuses, Capacitors. Evaporators. Classification of gas refrigeration machines. hardware units.

Purpose of studying of the discipline

The study of business processes and the theory of refrigerators, con constructions of elements and machines in general.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know thermodynamic theory, cycles and circuits chillers, compressors and construction machines, the interaction of components of refrigeration equipment.
2) Able to produce thermal design of the chiller and its components as select hardware commercially produced in accordance with the safety regulations and standards requirements.
3) Has the skills to work with the literature on the chiller.

Prerequisites

Physics Technical Mechanics Fluid Dynamics Thermodynamics Heat and Mass Transfer

Postrequisites

Basic and profile disciplines of the EP Final examination Refrigerators Bases for design and construction of refrigerating machines with elements of CAD Installation, diagnostics and repair of refrigeration equipment Heat pumps

Applied physics and radiation safety

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Applied physics and radiation safety" studies: radioactivity, interactions of radiation with matter, the biological effect of radiation, dosimetry. The theoretical basis of the existing methods for measuring the dose of radiation and activity is based on the study of the mechanism of interaction of various types of ionizing radiation with matter. Methods of dosimetry and protection, where radioactive substances are used, in particular in nuclear power engineering in the design and operation of nuclear reactors.

Purpose of studying of the discipline

Formation at students in students the Knowing and skills of using the foundations of radiation safety for life safety.

Learning Outcomes

ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the basic concepts of radioactivity, interaction of radiation with matter.
2) Able to perform calculations to determine the exposure, absorbed, and the expected effective dose.
3) Has skills forecasting possible radiological situation and its assessment, and also owns the methods of forecasting areas of radioactive contamination and internal destruction of human in extreme and emergency situations.

Prerequisites

Elementaric particle Physics

Postrequisites

Occupational health and safety in the Technical Physics

Principles of nuclear safety

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Principles of ensuring the safety of nuclear power plants" studies: analysis of the largest accidents at nuclear power plants, norms and rules of radiation safety, storage and handling of radioactive waste and spent fuel, probabilistic safety analysis, regulatory documents of the Republic of Kazakhstan in the field of the use of atomic energy to ensure quality and safety culture, the principle defense in depth, deterministic approach to safety, accident management.

Purpose of studying of the discipline

Obtaining knowledge by students on the basic principles of ensuring the safety of nuclear power plants, as well as the formation of skills in assessing the quantitative indicators of reliability and safety.

Learning Outcomes

ON2 Apply laws and regulations in the field of economics and law, ecology and life safety, as well as the skills of entrepreneurship, leadership, and receptivity of innovations.
ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.
ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.

Learning outcomes by discipline

1) Know the basic norms and rules of radiation safety; Principles of- treatment or storage of spent nuclear nym fuel and radioactive

waste.
2) Able to use standard documentation Kazakhstan in the field of atomic energy to ensure a safe life of the population.
3) Has skills forecasting an emergency at the plant and to take appropriate measures to eliminate its consequences are.

Prerequisites

Elementaric particle Physics

Postrequisites

Occupational health and safety in the Technical Physics

Radioecology and radiation safety

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Radioecology and radiation safety" studies: the processes of dosimetry of ionizing radiation, radiation transformation of nuclei and issues related to the formation of natural and man-made radiation background. The main factors that give the problems of radiation safety the character of a global problem. Formation of the radiation background. Dosimetry of ionizing radiation. The main significant for radioecology natural and artificial radionuclides. When calculating the equivalent dose, weighting factors for individual types of radiation.

Purpose of studying of the discipline

Theoretical and practical training of students on issues of radiation safety, ensuring safe work with sources of ionizing radiation, their dosimetry and control.

Learning Outcomes

ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.

Learning outcomes by discipline

1) Know the conditions of formation of the radiation situation at the expense of natural and anthropogenic factors, the main regulatory documents defining radiative Zion security environment and methods of its control.
2) Able to use the equipment, recording different types of ionizing radiation-present.
3) Has the skills to apply theoretical Knowing to work to improve radiation situation in conducting radiation research.

Prerequisites

Elementaric particle Physics

Postrequisites

Occupational health and safety in the Technical Physics

Atomic physics

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline studies intra-atomic and atomic processes and phenomena. The concepts, questions and provisions related to atomic physics are outlined. Leading to the formation of modern physics decisive experiments and hypotheses. Spectrum of atoms energy discreteness; nuclear model of the atom; quantum properties of radiation; Bohr`s theory; basic provisions of the quantum theory of atoms and atomic particles; quantum physics of many-electron and one-electron atoms, wave properties of particles.

Purpose of studying of the discipline

The study of the physical meaning and content of the basic laws and concepts of nuclear physics, establish the boundaries of applicability of these laws.

Learning Outcomes

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the basic concepts of quantum theory of the atom.
2) Able to put the basic physical experiments, which are based on the results of current understanding of the quantum nature of the atom particles and atomic structure.
3) Fluent skills solving the basic problems of atomic physics.

Prerequisites

Physics The nuclear and neutron physics Neutron transport theory Elementaric particle Physics Nuclear physics

Postrequisites

Basic and profile disciplines of the EP Final examination Energyequipment NEI Fundamentals of reactor physics Nuclear research reactors Controlled thermonuclear fusion Nuclear fuel cycle Quantum mechanics Computational methods in quantum physics Quantum mechanics of molecules

Theoretical Foundations of spectrometry

Discipline cycle	Basic disciplines
Course	3
Credits count	5

Knowledge control form	Examination

Short description of discipline
The course introduces the basic concepts of spectroscopy. Registration methods and measurement methods classification of spectral methods according to the type of transitions under study. Technique and instruments of spectroscopy characteristics of spectral lines. Features of the molecular and atomic spectra of the spectral device. Photoelectric methods, photo registration, visual registration of spectra. Methods experimental stationary spectroscopy. Luminescent, absorption, emission, laser spectroscopy and thermally stimulated luminescence.

Purpose of studying of the discipline
To familiarize students with the theoretical basics of spectroscopy and formation of common principles and concepts of devel-opment directions and co-temporal meth-ods spectrometry.

Learning Outcomes
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) He knows the basic stages of development of spectroscopy as a branch of science; classification of nuclear radiation spectrometers and their general characteristics; methods and means of spectrometry streams of charged particles and gamma radiation.
2) Able to determine the type of spectral in-strument necessary for spectral analysis of game-specific object.
3) Owns skills of practical work on the spectral plants and modern-use technology, applied in the processing of spectrometric analysis.

Prerequisites
Elementaric particle Physics

Postrequisites
Basic and profile disciplines of the EP Final examination Quantum mechanics Radiometry Spectrometry radiation and methods of recording radiation

The physics of the atom and atomic phenomena

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course is devoted to the study of the structure and states of atoms. Methods for solving problems related to finding the properties of atomic phenomena are given. Atomic models, discreteness of atomic states. Magnetic and mechanical moments of the atom. The interaction is superfine. Interaction of a quantum system with radiation. X-ray spectra. Atoms are multielectron. Orbital interaction - Spin. The simplest motions of microparticles. An atom in the field of external forces. Corpuscular-wave dualism.

Purpose of studying of the discipline
Mastering the basic theory of the atom as a generalization of the results of physical experiments and theoretical ideas about the motion of a microscopic object.

Learning Outcomes
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Know the basic experimental data and theoretical understanding of wave-particle duality in the nature of a microscopic object, the fundamental basis of wave description of the motion of a microscopic object and the quantization of its energy and momentum.
2) Able to calculate the basic dynamic variables for an electron in hydrogen-like systems, the magnetic moment of the electron shell of complex atoms.
3) Fluent skills systematization states of the electron shell of atoms, simple molecules; qualitatively describe the basic properties of atoms.

Prerequisites
Physics The nuclear and neutron physics Neutron transport theory Elementaric particle Physics Nuclear physics

Postrequisites
Basic and profile disciplines of the EP Final examination Controlled thermonuclear fusion Nuclear fuel cycle Quantum mechanics Computational methods in quantum physics Quantum mechanics of molecules

Physics of the condensed state

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
The subject "Physics of Condensed Matter" contains: Frohlich polaron, acoustic and optical phonons, plasmons, Frenkel and Wannier excitons, interaction of light with a crystal lattice, polaritons, boson condensation, kinetic properties of dielectrics, metals and semiconductors, Brillouon zone, energy bands, Born-Ehrenfest adiabatic principle, nonequilibrium electrons and holes , state of electrons in a crystal lattice, impurities and impurity levels, scattering of charge carriers, conductivity, superfluidity, electron-phonon interactions.

Purpose of studying of the discipline
Getting students ideas about the current state of science in the field of condensed matter physics.

Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for

the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) main physical phenomena, features of their occurrence; basic physical concepts, quantities, their mathematical expression and units of measurement; main methods of experimentation and processing of measurement results;
2) correctly correlate the content of specific tasks with the general laws of physics, effectively apply these laws to solve specific problems in the field of physics and on the interdisciplinary boundaries of physics;
3) skills and abilities in using the main measuring instruments, in solving specific problems of physics and their correlation with the general laws of physics.

Prerequisites

Physics

Postrequisites

Final examination

Physics of semiconductors and dielectrics

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The subject "Physics of semiconductors and dielectrics" contains: physical theories of semiconductors and dielectrics, contact phenomena in semiconductors, polarization of dielectrics, dielectric losses, electrical conductivity, thermal conductivity and heat capacity, scattering of electrons and holes in semiconductors, statistics of electrons and holes in semiconductors, generation and recombination of electrons and holes, optical and photoelectric phenomena in semiconductors, luminescence of semiconductors and dielectrics.

Purpose of studying of the discipline

Obtaining fundamental knowledge in the field of physics of semiconductors and dielectrics, as well as acquiring the skills necessary for their use in research activities.

Learning Outcomes

ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.

Learning outcomes by discipline

1) main physical phenomena, features of their occurrence; basic physical concepts, quanti-ties, their mathematical expression and units of measurement; main methods of experimentation and processing of meas-urement results;
2) correctly relate the content of specific prob-lems with the general laws of physics, ef-fectively apply these laws to solve specific problems in the field of physics and on the interdisciplinary boundaries of physics.
3) skills and abilities in using the basic physi-cal concepts, physical quantities, physical phenomena, their mathematical expression, their place and role in science and modern production;

Prerequisites

Physics

Postrequisites

Final examination

Solid state physics

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The subject "Physics of Solids" contains: the structure of crystalline solids, the structure and symmetry of solids, reciprocal lattice, simple and complex lattices, imperfections in crystals, anisotropy and symmetry of physical properties, tensor description, kinetic phenomena in metals and semiconductors, quantum mechanics of electrons in solids, optical properties of crystals, dielectric and magnetic properties of substances.

Purpose of studying of the discipline

Formation of indepth ideas about the basic physical processes, phenomena and regularities of solid state physics.

Learning Outcomes

ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) the basic principles of the theoretical description and study of crystalline solids;
2) independently, using basic methods and basic models of solid state physics, analyze the results of experimental studies;
3) taking into account the features of the crystal structure, electronic and phonon spectra, to perform quantitative assess-ments of the physical properties of solids;

Prerequisites

Physics

Postrequisites
Final examination

Refrigerators

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination and term work/Project

Short description of discipline
The discipline " Refrigerators " studies: Rational design of refrigeration units with the development of modern refrigeration systems. Types of refrigeration units in food and other industries. Cooling methods. Schemes and cycles of refrigeration units. Scope and properties of coolants. Calculation and selection of the main and auxiliary equipment. Varieties of refrigeration units according to their features, according to which their field of application is selected. Refrigeration transport. Small refrigeration units.

Purpose of studying of the discipline
The study of the basic and fundamental provisions of the rational design of refrigeration systems, given the current development of refrigeration.

Learning Outcomes
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Knows the application of different cooling systems, refrigeration units of various schemes.
2) Umeetrasschityvat, design and testing elements of refrigeration.
3) Has skills to use methods of calculation and design of thermal insulation refrigerated facilities.

Prerequisites
Thermodynamics Heat and Mass Transfer Chillers

Postrequisites
Basic and profile disciplines of the EP Final examination

Nuclear research reactors

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination and term work/Project

Short description of discipline
The discipline "Nuclear Research Reactors" studies: the physical foundations of design, the physical features of NIR, the classification of NIR, the physics of some NIR, experimental facilities for materials science reactors, the features of heat transfer and hydrodynamics of NIR, loop facilities, design and technological schemes, development trends of NIR, research nuclear reactors play important role in the development in the development of nuclear technology and many fundamental sciences.

Purpose of studying of the discipline
The theoretical and practical preparation of students for work related to the study of the fundamental and comprehensive schemes of individual elements and plants in general.

Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Know the scope of nuclear research reactors.
2) Umeetrasschityvat necessary characteristics of the radiation field, dose and dose rate.
3) Has skills in the selection of technically and economically feasible solutions for the distribution of processes in the energy circuit.

Prerequisites
Physics The nuclear and neutron physics Neutron transport theory Theoretical Foundations of spectrometry Atomic physics The physics of the atom and atomic phenomena Elementaric particle Physics Nuclear physics

Postrequisites
Basic and profile disciplines of the EP Final examination ACS processes NPI

Basics cryosystems

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Fundamentals of cryosystems" studies: ideas about the areas of implementation of low-temperature processes and the behavior of substances at low temperatures, gas and vapor compression refrigeration machines, reverse thermodynamic cycles, thermomechanical effects, compressed gas throttling, the Joule- Thompson effect, isentropic gas expansion, differential and integral choke-effects, desorption cooling, vapor recovery cooling, He3-He4 dilution refrigerators.

Purpose of studying of the discipline

To study in conducting materials at low temperatures, to form ideas about the implementation of low-temperature processes.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Knows the features of the behavior of substances at low temperatures, the main properties of cryogenic liquids.
2) Able to make recommendations to ensure that the benefits of energytion mode.
3) Fluent in methods of calculation and determination of the optimum parameters of cryogenic vacuum systems.

Prerequisites

Physics Thermodynamics Heat and Mass Transfer Chillers

Postrequisites

Basic and profile disciplines of the EP Final examination

Processes and equipment of cooling gas

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Processes and apparatus for gas cooling" studies: liquefaction of gases, characteristics of air coolers (ACU), transportation and storage of chilled and liquefied gases, theoretical foundations for calculating heat exchangers, joint operation of air coolers and a gas pipeline, regasification of liquefied gases, their use in process plants , apparatuses and technologies, areas of application of gas cooling apparatuses, physical principles underlying the design of cooling apparatuses.

Purpose of studying of the discipline

To give students needed-mye Knowing and skills on the use of devices and technologies used for cooling gases.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the principle of the device and the action-tion devices deep cooling and liquefying gases.
2) Able to count modes regasification and select the appropriate equipment.
3) Has skills in analysis mode sets the objective display-makers and the management of these regimes.

Prerequisites

Physics Thermodynamics Heat and Mass Transfer Chillers

Postrequisites

Basic and profile disciplines of the EP Final examination

Thermophysical processes in cryogenic systems

Discipline cycle	Profiling discipline
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Thermophysical processes in cryogenic systems" studies: transient processes in a heated channel, axial thermal conductivity in a cooled rod, thermal- hydraulic processes in cryogenic pipelines, transient processes in pipelines, non- stationary processes in isolation, thermophysical processes in cryo- reservoirs, cooling of cryo- liquids, gasification of cryo- liquids, in low-temperature insulation heat transfer, insulation technology, in non-stationary thermal-hydraulic processes, physical and mathematical models, basic equations of flow motion.

Purpose of studying of the discipline

To study the behavior of materials at low temperatures.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know thermal hydraulic processes in cryogenic piping; especiallysti behavior of substances at low temperarounds, the main properties of cryogenic liquids.
2) Able to analyze thermophysical-physical processes taking place in the technological units.
3) Fluent in methods of calculation and determination of the optimum parameters of cryogenic vacuum systems.

Prerequisites

Physics Thermodynamics Heat and Mass Transfer Chillers

Postrequisites

Basic and profile disciplines of the EP Final examination

Information technology and tech-niques in engineering education

Discipline cycle	Basic disciplines
Course	3

Credits count	5
Knowledge control form	Examination

Short description of discipline
Discipline " Information technology and tech-niques in engineering education " students must master the use of modern technology and technology in engineering education. Modern information technologies in engineering education based on the development of computer facilities.
The use of modern multimedia teaching aids and methods of their development.
Distance systems in education. Innovative technologies in the implementation of the system of control, evaluation and monitoring of educational achievements.
Purpose of studying of the discipline
Formation of readiness for the use of inno-vative technologies and techniques in the educational environment.
Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
Learning outcomes by discipline
1) Knowledge of the main components of the innovative technologies used in education.
2) To be able to take advantage of the new information, communication educational environment for the realization of person- ality-oriented training model.
3) Have skills in the use of test programs and monitoring of the educational process.
Prerequisites
Introduction to Specialty Computer technologies in the energy sector Information and communication technology
Postrequisites
Basic and profile disciplines of the EP Final examination

Basics of modern energy in English

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
Discipline " Basics of modern energy in English " students must master the basics of production and transportation of energy in English. And also have a general idea about energy. Features of devices and operation of power plants. Theoretical foundations of the processes accompanying the production of electricity. Interaction of energy objects with the environment. Indicators of thermal and general efficiency of power plants. Alternative energy sources.
Purpose of studying of the discipline
mastering the basics of energy production and transportation in English
Learning Outcomes
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
Learning outcomes by discipline
1) describes the technological schemes for the production of electrical and thermal energy
2) explains the principles of operation of the main and auxiliary equipment of power plants
3) identifies urgent problems and tasks in the field of environmentally friendly transformation of energy carriers
Prerequisites
Foreign language
Postrequisites
Basic and profile disciplines of the EP Final examination

Formation of the technical thesaurus

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
Discipline "Formation of the technical thesaurus" students must form professionally significant skills and qualities necessary for the effective development and creation of a thesaurus-type terminological lexicon on a specific topic, problem, field of knowledge as an information basis and means of high-quality oral and written translation of scientifically -technical texts when exchanging between native speakers of different languages in a particular field of science through lexical means.
Purpose of studying of the discipline
Formation of professionally significant skills and qualities necessary for the effec-tive design and creation of terminological vocabulary thesaurus type on a particular topic, domain of knowledge as an infor- mation basis and means for quality of in- terpretation and translation of scientific and technical texts in the implementation of exchanges between speakers of different languages.
Learning Outcomes
ON1 Demonstrate socio-cultural, economic, legal, environmental knowledge, communication skills, apply information technology, taking into account modern trends in the development of society.
ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their

subject area.

Learning outcomes by discipline

1) Knowledge of the structure and model vo- cabulary, thesaurus, technology, stages of development and principles of vocabulary thesaurus.
2) The ability to analyze in detail-thematic content of the information text materials, the selection of keywords, referents on specific topics
3) have all kinds of professional skills of read-ing (the reference and informative).

Prerequisites

Introduction to Specialty

Postrequisites

Basic and profile disciplines of the EP Final examination

Basics of Heat Transformation

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Fundamentals of Heat Transformation" studies: vapor-liquid compression heat transformers (refrigeration and heat pump installations), thermodynamic foundations of heat transformation processes, operation of vapor-liquid compression heat transformers under off-design conditions, pressure and expansion machines of heat transformers, their energy characteristics, jet heat transformers, absorption transformers heat, liquefaction and freezing of gases, low-temperature separation of gas mixtures, gas-liquid compression heat transformers.

Purpose of studying of the discipline

The generation of knowledge about the principles of the most effective or optimal conversion of different types of energy.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Knows the basics of heat transformation theory for various settings of the compres-sion, absorption, jet type.
2) Able to identify all heat transformers (heat pumps, refrigeration and combined units) the main parameters and energy efficiency.
3) Has the skills to conduct the calculation schemes and processes taking place in the TT, with the definition of targets and efficiency ratios.

Prerequisites

Physics History of the development of energy Basics of Alternative Energy Introduction to Specialty Thermodynamics Heat and Mass Transfer Alternative and renewable energy sources

Postrequisites

Basic and profile disciplines of the EP Final examination

Heat pumps

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Heat pumps" studies the prospects for the use of heat pump installations. Sources of low-potential heat. Indicators and analysis of energy efficiency of various types of heat pumps. Classification of heat pump installations. Schemes and principles of operation of heat pump installations. Heat supply systems with heat pumps. For individual heat supply, in district heating systems and industry, the use of heat pumps. Industrially produced heat pump installations.

Purpose of studying of the discipline

Formation of knowledge and skills needed in professional activities in the field of en-ergy saving in the production process, car-ried out with the use of IP-heat pump in-stallations.

Learning Outcomes

ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) describes the prospects for the use of heat pump units and their classification
2) determines the optimal operating parameters of heat pump units
3) makes thermal and structural calculations related to the design of heat pump installations and systems using them.

Prerequisites

Physics Basics of Alternative Energy Introduction to Specialty Fluid Dynamics Thermodynamics Heat and Mass Transfer Alternative and renewable energy sources Air conditioning and ventilation

Postrequisites

Basic and profile disciplines of the EP Final examination Bases for design and construction of refrigerating machines with elements of CAD Automation of refrigeration Installation, diagnostics and repair of refrigeration equipment

Heat and mass transfer in power plants

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Heat and Mass Transfer in Power Plants" prepares bachelors in the field of heat and mass transfer phenomena and technical systems and processes based on them. Heat transfer processes on physical bases, heat conduction during stationary processes, non-stationary heat conduction processes, convective heat transfer, diffusion processes, heat transfer during condensation and boiling, heat transfer by radiation, complex heat transfer, heat exchangers in power plants, heat carriers, heat exchangers and their calculation.

Purpose of studying of the discipline
Bachelor in the field of transport phenom-ena of heat and mass, and technical sys-tems and processes based on them.

Learning Outcomes
ON3 To apply in cognitive and professional activities basic knowledge in the field of mathematics and physics, methods of mathematical analysis and modeling, theoretical and experimental research.
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Knows thermal processes in devices for the conversion and use of energy.
2) Able to perform calculations of equipment of heat and mass transfer, to select standard and optional accessories based on calculations.
3) Has skills in choicing of working bodies, heat generating and heat emitting equipment, heatinsulating materials, heat and mass transfer process intensification techniques.

Prerequisites
Physics History of the development of energy Basics of Alternative Energy Introduction to Specialty Fluid Dynamics Thermodynamics Heat and Mass Transfer Alternative and renewable energy sources

Postrequisites
Basic and profile disciplines of the EP Final examination

Computational methods in quantum physics

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course covers the main numerical methods of quantum simulation: the Monte Carlo method and the exact diagonalization method. Wave functions of an adequate discrete basis - the choice of a method, finding the correlation functions and the spectrum of systems described by the main types of quantum statistics - Fermi, Bose and spin. Problems of thermodynamic temperature characteristics and numerical analysis of various systems have been studied; the acquaintance of correlated states in modern models of physics was carried out: spin Bose-Hubbard, Hubbard models

Purpose of studying of the discipline
Mastering the basic principles of computational experiment-ment and familiarity with basic computational-tive methods for solving problems in atomic physics, quantum theory of collisions and the physics of molecular clusters.

Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Know the basic computational methods for solving mathematical physics;
2) Knows how to formalize the statement of the problem, to conduct its classification and to select the optimal solution method.
3) Fluent in the skills of the individual mo-calculations in quantum physics.

Prerequisites
Physics The nuclear and neutron physics Neutron transport theory Theoretical Foundations of spectrometry Atomic physics The physics of the atom and atomic phenomena Nuclear physics

Postrequisites
Basic and profile disciplines of the EP Final examination

Quantum mechanics

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline
This discipline studies: fundamental principles of quantum mechanics, fundamentals of quantum mechanics in experiments, the simplest application of the Schrödinger equation, the mathematical apparatus of quantum mechanics, representation theory, the

formulation of the matrix of quantum mechanics, the theory of angular momentum of quantum mechanics, the movement of bodies in a centrally symmetric field, approximate methods of quantum mechanics, from identical particles the foundations of systems theory, the methods of Thomas-Fermi and Hartree-Fock, relativistic elements of quantum mechanics.

Purpose of studying of the discipline

To give students representation, the physical content of quantum mechanics, and me-depth understanding of natural-stey microcosm.

Learning Outcomes

ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) explains the basic physical laws of quantum mechanics

2) uses fundamental concepts of nonrelativistic quantum mechanics and such important concepts as potential well, harmonic oscillator, tunnel effect, addition of moments of quality of motion, particle statistics, particle spin, Pauli`s principle

3) applies the mathematical apparatus of nonrelativistic quantum mechanics and principles to solve standard problems of quantum mechanics

Prerequisites

Physics The nuclear and neutron physics Neutron transport theory Theoretical Foundations of spectrometry Atomic physics The physics of the atom and atomic phenomena

Postrequisites

Basic and profile disciplines of the EP Final examination

Quantum mechanics of molecules

Discipline cycle	Basic disciplines
Course	3
Credits count	5
Knowledge control form	Examination

Short description of discipline

The course contains a presentation of the basic principles that underlie modern quantum chemistry. The main provisions and approximations used to study the electronic and spatial structure of molecules are formulated. An idea is given about point symmetry groups and methods for solving applied problems of quantum chemistry using group theory methods. Modern methods used to calculate various physicochemical properties of molecules are outlined.

Purpose of studying of the discipline

Getting practical skills describe the structure of molecular systems in the language of quantum mechanics using the symmetry of the problem.

Learning Outcomes

ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Knows the methods of modern quantum-ing chemistry and approximate methods for solving the model quantum problems

2) Able to analyze the results of calculations of energy and electron distribution in the molecule, of.

3) Fluent skills in solving practical problems in quantum chemistry.

Prerequisites

Physics The nuclear and neutron physics Neutron transport theory Theoretical Foundations of spectrometry Atomic physics The physics of the atom and atomic phenomena Nuclear physics

Postrequisites

Basic and profile disciplines of the EP Final examination

Specifications and technical documentation on labor protection

Discipline cycle	Basic disciplines
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline

In this discipline " Specifications and technical documentation on labor protection " documentation is considered in the preparation of action plans for labor protection. Legal basis for regulating relations in the field of labor protection between employers and workers. State regulatory requirements for labor protection. Normative documentation of the labor protection service. Accounting and reporting documents for accident insurance. Labor protection training.

Purpose of studying of the discipline

Formation of Knowing in the field of technology, safety and health.

Learning Outcomes

ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.

ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.

Learning outcomes by discipline

1) Know the basics of labor protection legislation.

2) Umeetsostavlyat reporting Article cally documentation on labor protection.
3) Has skills of the organization of work to ensure the safety of labor in subtions.

Prerequisites

Bases of economics, law and ecological knowledge

Postrequisites

Final examination

Occupational Safety and Health

Discipline cycle	Basic disciplines
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline

The subject of study of the discipline "Labor protection" is: legal and organizational issues of labor protection, as well as the legal and organizational foundations of labor protection, the basic concept and subject of labor protection, occupational health and industrial sanitation, the basics of physiology, fire safety, legal, socio- economic , medical and preventive, sanitary and hygienic, protective equipment and safety devices, organizational, technical, rehabilitation and other measures.

Purpose of studying of the discipline

Formation of the required level of Knowing and skills in legal and organizational matters of occupational safety.

Learning Outcomes

ON2 Apply laws and regulations in the field of economics and law, ecology and life safety, as well as the skills of entrepreneurship, leadership, and receptivity of innovations.
ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.
ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.

Learning outcomes by discipline

1) Know the laws that reflect the issues of health and safety.
2) Umeetsostavlyat documentation on labor protection.
3) Has skills fill registers work on OT and briefing.

Prerequisites

Bases of economics, law and ecological knowledge

Postrequisites

Final examination

Occupational health and safety in the Technical Physics

Discipline cycle	Basic disciplines
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline

In this discipline, the system of labor safety standards is considered. Legislative framework for safety and labor protection, industrial sanitation, fire safety, protective equipment and safety devices, labor protection at nuclear power plants, safety precautions: when working with low- boiling liquefied gases and pressurized systems: when working at heat engineering installations: when work on electrical installations.

Purpose of studying of the discipline

Formation at students basic Knowing on labor protection, allowing to conduct independent work on the organization of safety and health conditions at work.

Learning Outcomes

ON2 Apply laws and regulations in the field of economics and law, ecology and life safety, as well as the skills of entrepreneurship, leadership, and receptivity of innovations.
ON4 Apply in the educational, scientific and professional activities the requirements of the rules and standards of documentation.
ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.

Learning outcomes by discipline

1) Knows the main legislative acts and regulations on labor protection, methods for assessing working conditions and analyzing the causes of industrial injuries and occupational diseases, information about fire and accidents, about dangerous and harmful production factors.
2) Able to assess and optimize working conditions, analyze the causes and predict the conditions of industrial injuries, occupational diseases and emergencies.
3) Has the skills to determine the main parameters of the fire hazard of substances and structures, hazardous and harmful production factors, develop and organize protective measures against these factors.

Prerequisites

Bases of economics, law and ecological knowledge

Postrequisites

Final examination

The basic technology of production of consumers of artificial cold

Discipline cycle	Profiling discipline
Course	4
Credits count	5

Knowledge control form	Examination

Short description of discipline
The discipline "Fundamentals of technology for the production of consumers of artificial cold" studies: in obtaining theoretical knowledge in the field of the use of artificial cold, drying, cooling, desorption, absorption, condensation, rectification, crystallization, adsorption, freeze drying, technological processes of chemical and food production, their classification, composition and properties of chemicals and food products, laws of chemical, physical transformations of substances, in the field of chemical and food production, the use of artificial cold.

Purpose of studying of the discipline
Providing deep theoretical Knowing and practical experience in the application of artificial cold.

Learning Outcomes
ON5 Use the fundamental laws of mechanics, thermodynamics, heat and mass transfer and their practical applications.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Know svoystvahimicheskih substances and foods, manufacturing technology of chilled, frozen food and chemical industries.
2) Able to organize the storage of chilled and frozen products, technically competent and skillfully choose and maintain the technological parameters of cold storage.
3) It has skills methods of determining the length of the cooling number control rolling and storage; possession sposobamiopredeleniya design parameters devices of chemical manufactures.

Prerequisites
Refrigerators Chillers

Postrequisites
Final examination

Fundamentals of reactor physics

Discipline cycle	Profiling discipline
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Fundamentals of Reactor Physics" introduces students to a number of ideas, models and concepts used in nuclear reactor physics. It is also devoted to the methods of experimental studies of the neutron field and the physical theory of reactors. Neutron- physical features and calculation of power reactors; theory of critical dimensions; lattice theory; physical classification of reactors; neutron multiplication factor; classification of experiments; neutronic characteristics determined in experiments on assemblies and reactors.

Purpose of studying of the discipline
Development representation of the physics of nuclear reactors.

Learning Outcomes
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Know the classification of nuclear reactors; the relationship between the calculated and experimental-mental studies.
2) Able to carry out calculations of power reactors.
3) Has skills neutron-physics calculations on a computer.

Prerequisites
The nuclear and neutron physics Neutron transport theory Energyequipment NEI Nuclear research reactors Theoretical Foundations of spectrometry Atomic physics The physics of the atom and atomic phenomena Elementaric particle Physics Nuclear physics

Postrequisites
Final examination

Bases for design and construction of refrigerating machines with elements of CAD

Discipline cycle	Profiling discipline
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline " Bases for design and construction of refrigerating machines with elements of CAD " gives skills in performing design and research work on designing based on CAD tools and designing and calculating typical elements of modern refrigeration machines. Heat exchangers of the type "mixing-mixing", "mixing-displacement", "displacement-displacement" and their mathematical models. General methods for calculating reciprocating compressors. Basic construction materials.

Purpose of studying of the discipline
To equip students with the skills of designing and calculating the typical elements of modern machines and refrigerators perform computational research work on the design based on CAD tools.

Learning Outcomes
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline
1) Know the methods and principles for design elements, assemblies and parts of refrigeration equipment.

2) Able to prepare terms of reference for the design of refrigeration, to make a constructive settlement of the chiller and its components, to develop blueprints and other technical documentation.
3) Has the skills of designing refrigeration equipment of various structural materials to meet the requirements of regulatory and technical documentation.

Prerequisites

Physics Mathematics Technical Mechanics Fluid Dynamics Elements of computer graphics and CAD bases in technical physics Refrigerators Chillers

Postrequisites

Final examination

Controlled thermonuclear fusion

Discipline cycle	Profiling discipline
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline "Controlled thermonuclear fusion" gives an idea of thermonuclear fusion, the physical properties of plasma, and the energy of the future. Binding energy of nuclei, fission and fusion, high- temperature plasma, tokamak- type facilities, "Big ITER": parameter estimation, engineering issues of creating tokamak magnetic field windings, plasma equilibrium, Grad-Shafranov equation, ohmic plasma heating, tokamak electromagnetic system, toroidal magnetic system , a fusion power reactor based on a tokamak.

Purpose of studying of the discipline

Give an idea of thermonuclear synthesis, physical properties - plasma, about the future of energy.

Learning Outcomes

ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) He knows the basic laws of nuclear fission and fusion; basic physical properties; methods of observation and ex-perimental research.
2) Able to formulate the basic concepts of the law of electromagnetism.
3) Owns skills of performing electromagnetic equations and quantum physics.

Prerequisites

The nuclear and neutron physics Neutron transport theory Energyequipment NEI Nuclear research reactors Atomic physics The physics of the atom and atomic phenomena Elementaric particle Physics Nuclear physics

Postrequisites

Final examination

Spectrometry radiation and methods of recording radiation

Discipline cycle	Basic disciplines
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline

The course introduces and also expands students` knowledge of radiation spectrometry on the basic concepts of radiometry, spectrometry and dosimetry of nuclear radiation, as well as methods for detecting radiation using semiconductor, scintillation, and gas-discharge detectors, and characteristics of recording systems. Mass spectrometry methods; problems of obtaining and recording spectra. Infrared (IR) spectra and Raman scattering of light; methods of electron spectroscopy.

Purpose of studying of the discipline

Introduction to modern scientific equipment, the main types of dosimeters, radiometers, spectrometers and other equipment used in radiation physics, ecology and biology.

Learning Outcomes

ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the properties and characteristics of ionizing radiation; the basic concepts and requirements for dosimetry instrumental methods of dosimetry and spectroscopy.
2) Able to skillfully choose and use of dosimetric and spectrometric equipment.
3) Has skills of dosimetric and spectrometric measurementstions.

Prerequisites

Introduction to Medical Physics Nuclear research reactors Theoretical Foundations of spectrometry

Postrequisites

Final examination

Physics of radiation protection

Discipline cycle	Basic disciplines
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course "Physics of Radiation Protection" is a course that deals with: issues of the impact of ionizing radiation on humans and the environment; methods for calculating protection against gamma and neutron radiation; basic regulatory documents on radiation safety when working with sources of ionizing radiation and in the design, construction and operation of nuclear power plants.; methods of registration of ionizing radiation; organization of the radiation safety system at nuclear power plants.
Purpose of studying of the discipline
Formation of the student basic Knowing of protection against ionizing radiation.
Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
Learning outcomes by discipline
1) Know about the sources of ionizing radiation in nuclear power plants; weakening of the laws of ionizing radiation in matter; of primary and secondary protection; the basic provisions of the rules of radiation Security.
2) Able to calculate the dose and dose rate of the elementary radiation sources.
3) Has skills of radiation monitoring devices and installations that use sources of ionizing radiation.
Prerequisites
Applied physics and radiation safety Nuclear research reactors
Postrequisites
Final examination

Radiometry

Discipline cycle	Profiling discipline
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline "Radiometry" aims to familiarize students with the physical foundations of the interaction of radiation with matter, methods of their registration; with the basics of radiometry methods, their capabilities and tasks to be solved. Brief description of the properties of radioactive radiation. Theoretical foundations of radiometry. Classification of methods of radiometric measurements. Methods of radiometric measurements.
semiconductor counters. Optical methods. radiography method. Fundamentals of activation analysis. Application of radiometric methods for the analysis of ores, concentrates, salts.
Purpose of studying of the discipline
The fundamental study of the foundations of radiometry and their application in the nuclear industry.
Learning Outcomes
ON7 Apply laws describing the flow of physical processes in the microworld, the mathematical apparatus of non-relativistic quantum mechanics, methods for calculating the physical properties of materials, assessing the applicability of approximations in educational, research and practical activities.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
Learning outcomes by discipline
1) Know the laws of radioactive decay; family radioactive uranium and thorium actinouranium; types and properties of radiation; the laws of interaction of radiation with matter; measurement principles of various types of radiation.
2) Able to use the law of decay of activity and to calculate the mass of radioactive substances; perform calculations speed changes when passing bills ra-radioactive radiation through matter.
3) Has skills radiochemical separation of daughter products of decay of natural radioactive elements; of radiometric measurements.
Prerequisites
Applied physics and radiation safety Energyequipment NEI Nuclear research reactors
Postrequisites
Final examination

Automation of refrigeration

Discipline cycle	Profiling discipline
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline
The study of the discipline " Automation of refrigeration " students are the devices, the principles of operation of the main means of automation, the basics of automatic control and regulation of the operation of the refrigeration unit, and air conditioning systems. Regulation of operation and parameters of refrigeration machines and installations. Establishing the boiling point in the evaporator of refrigeration machines. Automation of refrigeration machines and installations. Building the characteristics of the refrigeration machine. Smooth and step-toe (positional) regulation of cooling capacity.
Purpose of studying of the discipline
The study of the students unit, the operating principle of the basic means of automation, fundamentals of automatic control and regulation of the refrigeration plant and air conditioning systems.
Learning Outcomes
ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their

subject area.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Knows the methods for measuring technological parameters refrigeration production, operating principles and devices monitoring and adjustment of parameters
2) Able to produce a variety of control equipment technologicalray parameters, read the function chart.
3) Has the skills of practical application of acquired Knowing in the field of automation and protection elements refrigeration

Prerequisites

Elements of computer graphics and CAD bases in technical physics Refrigerators Chillers Electrical engineering and electronics

Postrequisites

Final examination

ACS processes NPI

Discipline cycle	Profiling discipline
Course	4
Credits count	5
Knowledge control form	Examination

Short description of discipline

The discipline " ACS processes NPI " studies Emergency protection and signaling systems, types of emergency situations and main signals, protection by power level and acceleration period, emergency and warning signaling. Reactor power control. The main elements and their characteristics classification of control systems of automatic control systems. Reactor power control and power distribution system description of the reactor as a control object and thermal control.

Purpose of studying of the discipline

Training of specialists in the field of automated process control systems at nuclear power plants and nuclear power units.

Learning Outcomes

ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the basic principles of regulation and mathematical description of a Dean-ics objects and systems; principles and means of automation control, protection and control of technological processes at nuclear power plants and nuclear power units.
2) Able to choose the control scheme; transform and simplify the structure of the scheme; analyze the stability and quality performance of the automatic control system.
3) Has the ability to use mathematical models and software com-plexes for the numerical analysis of the totality of the processes in the nuclear power and thermal mechanical equipment of the plant.

Prerequisites

Elements of computer graphics and CAD bases in technical physics Energyequipment NEI Nuclear research reactors Electrical engineering and electronics

Postrequisites

Final examination

Installation, diagnostics and repair of refrigeration equipment

Discipline cycle	Profiling discipline
Course	4
Credits count	6
Knowledge control form	Examination

Short description of discipline

The discipline " Installation, diagnostics and repair of refrigeration equipment " gives an idea. When carrying out installation work, preparatory work on planning and preparation of technical documentation. Installation of pipelines. Safety precautions during all stages of installation work. Start-up and commissioning of the refrigeration unit. Safety precautions during repair work. Delivery of the freon refrigeration unit after installation and operation.

Purpose of studying of the discipline

Preparation of students for industrial and technical activities-sti-related diagnostics, repair, installation, service and efficient operation of refrigeration equipment.

Learning Outcomes

ON6 Operate knowledge in the field of electrical engineering, measuring instruments, electronics and information technology in their subject area.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) Know the structure of a technical dia-gnostics; Modern methods for the determination of defects, diagnosis algorithms; progressive methods of operation, service and maintenance of refrigeration equipment.
2) Able to analyze the technical condition of machines to perform the necessary calculations, to design and construct refrigeration industry.
3) Has skills of drawing up algorithms for diagnosis, choice of means of control and measuring diagnosed parameters in terms of the technical and economic feasibility.

Prerequisites

Refrigerators Chillers Air conditioning and ventilation Heat pumps

Postrequisites
Final examination

Nuclear fuel cycle

Discipline cycle	Profiling discipline
Course	4
Credits count	6
Knowledge control form	Examination

Short description of discipline
The discipline "Nuclear Fuel Cycle" studies: ensuring radiation safety at different stages of the fuel cycle, environmental consequences, and the potential danger of technological processes of nuclear energy. Decommissioning of a nuclear power plant: dismantling, conservation, nuclear power and public opinion. Impact of a nuclear power plant on the environment. Fuel handling: radioactive waste, problems of their disposal and disposal, uranium-thorium, plutonium fuel.
Purpose of studying of the discipline
Systematics of the main problems of the nuclear fuel cycle, a comparative evaluation of economic and environmental aspects of nuclear energy.
Learning Outcomes
ON2 Apply laws and regulations in the field of economics and law, ecology and life safety, as well as the skills of entrepreneurship, leadership, and receptivity of innovations.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
Learning outcomes by discipline
1) Knows particular cycle of neutron in a nuclear reactor; ways of defining and profiling of energy; materials of nuclear reactors and power plants.
2) He knows how to use the techniques of engineering calculations of nuclear reactors.
3) He has the skills of performance schemes, nomograms, and other relevant professional image.
Prerequisites
Energyequipment NEI Nuclear research reactors
Postrequisites
Final examination

Prediploma practice

Discipline cycle	Profiling discipline
Course	4
Credits count	15
Knowledge control form	Total mark on practice

Short description of discipline
The purpose of the undergraduate practice is to complete the writing of a thesis using the experience and knowledge gained during the pre-graduate research work with the implementation of the tasks. Preparation of diplom work in accordance with all requirements.
Purpose of studying of the discipline
Improving the quality of training students by mastering the methods and techniques of processing the material collected during the internship for writing and defending a graduation project.
Learning Outcomes
ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.
ON10 Проводить технико-экономические обоснования эффективности работы энергетических систем в области высоких и низких температур, энергосберегающего оборудования с использованием необходимых материалов действующих производств.
Learning outcomes by discipline
1) uses the rules and regulations for the design, construction, installation and operation of energy systems and installations;
2) plans to conduct scheduled tests and repairs of technological equipment, installation, commissioning and start-up work, including when mastering new equipment and (or) technological processes, in the implementation of fundamentally new waste-free processes and complexes;
3) takes the necessary measures to ensure the safety of life and environmental protection during the production, construction and operation of power plants and systems
Prerequisites
Manufacturing practice II
Postrequisites
Final examination

Manufacturing practice III

Discipline cycle	Profiling discipline
Course	4
Credits count	15
Knowledge control form	Total mark on practice

Short description of discipline
The objectives of the production practice are to consolidate and deepen the theoretical knowledge gained after studying the core

disciplines and to acquire practical skills and competencies in the field of professional activity and to train competitive specialists to work in the field of nuclear technology and engineering and physics of low temperatures.

Purpose of studying of the discipline

Consolidation and deepening of the theoretical knowledge gained in the process of studying at the university, the implementation of the adaptive capabilities of the student to new working conditions, as well as the development of skills and mastery of professional knowledge.

Learning Outcomes

ON8 Use the rules of work organization with compliance with safety requirements on the basis of the relevant legislative and regulatory framework in the field of labor protection, radiation safety, fire safety in the energy sector.
ON9 To substantiate the methods of calculation and selection of equipment for the nuclear industry, alternative and renewable energy for the production of cold, ventilation and air conditioning systems based on the achievements of science and technology.

Learning outcomes by discipline

1) be able to carry out technological, thermal and hydraulic tests of the equipment;
2) readiness to plan and participate in scheduled tests of technological equipment;
3) readiness to plan and participate in scheduled tests and repairs of technological equipment, installation, commissioning and start-up works, including the development of new equipment and (or) technological processes;

Prerequisites

Manufacturing practice II

Postrequisites

Final examination