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 2024

Semey 2024

Developed
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The head of the AK Kasymov Askar
OP Manager Aldazhumanov Zhan

Reviewed
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at a meeting of the University Academic Council by protocol No. 6 of June 18, 2024.

Introduction to Specialty

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

Short description of discipline
The Introduction to Specialty discipline 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 heat carriers; 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 History of Energy Development discipline forms knowledge on the history of the development of science and technology in the field of energy. Methodological foundations of the history of science and technology development; creation of a steam turbine; the invention of the steam engine; historical and technical prerequisites for the emergence of qualitatively new technical facilities; cycles of steam power plants, internal combustion engines, gas turbine plants, jet and rocket engines, nuclear thermal 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 Fundamentals of Unconventional Energy
discipline forms the general principles of the fundamentals of unconventional energy in solving problems of energy use in thermal technology production; within the framework of environmental problems of energy and the dynamics of energy consumption of energy sources and the development of the energy sector; the place of non- traditional energy needs of non- traditional energy sources. Geothermal energy; solar energy installations; the physical basis of the conversion processes 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 Computer Technologies in Energy Industry discipline forms the knowledge of students in the field of using computer equipment in calculations of heat and power processes; Excel table processors, MathCAD mathematical packages, DBMS, information systems; application of methods of solution of linear systems in heat engineering calculations, transcendental, non-linear, stationary and non-stationary heat conduction equations; construction of models of heat and power objects; application of finite difference methods to convective heat transfer equations.

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

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 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 microworld. Optics of the eye, optical systems of a microscope, optics of photographic and optoelectronic and television systems, reproduction and projection optical systems, analysis of computer modeling of optical systems, and assessment of image quality.

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

Applied Electronics

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

Short description of discipline

Basic properties of semiconductor materials, processes occurring in p-n-junction are considered. The device and principle of operation of electronic elements based on the use of p-n-junction is examined, as well as methods of calculation of electronic circuits based on these devices. The second part of the discipline examines digital elements and devices, methods of minimising 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

Theoretical basics of heat engineering

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

Short description of discipline

Theoretical Fundamentals Of Heat Engineering discipline studies the most rational ways of using heat, analysis of the efficiency of the working processes of thermal installations, to create new and most advanced types of thermal units with skillful combination of these processes. Without this it would be impossible to create powerful steam and gas turbine units, jet engines and other types of complex thermal units. There are two fundamentally different uses of heat: energetic and 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

Thermal Engineering discipline studies the basic laws of heat and mass transfer of thermal and caloric properties of substances interconversion of energy, heat and work. It is a science that studies heat engine cycles, stationary and unsteady heat conduction, methods of heat transfer, differential equation of heat conduction, types and classification of fuels, methods of fuel combustion, as well as methods of obtaining, conversion, transfer and utilization of heat, and carrying out standard thermal 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

Thermodynamics discipline studies basic concepts and definitions. Ideal gas low. Gas mixtures. The first and second laws of thermodynamics. Phase transitions and equilibrium of thermodynamic systems. Real gases. T-S and h-S diagrams and thermodynamic tables of state of matter. Thermodynamic properties of water and water vapor. h-d diagram of moist air. Wet air drying processes. Throttling. Thermal 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

Elementaric particle Physics

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

Short description of discipline
The Participle Physics discipline studies the basic concepts and concepts of quantum field theory; the concept of elementary particles; quantization of electromagnetic field; lagrangian approach in field theory; actual scalar field; complex scalar field; amplitudes and transition probabilities; interaction representation; mass and spinspirality; Erlangen program; generators of translations; generators of rotations; the first Casimir operator and 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

Electrical engineering and electronics

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

Short description of discipline
This discipline course consists of two sections: electrical engineering and electronics. Study of the discipline is based on the theory and practical application of linear, non- linear electric 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 characterising electromagnetic phenomena are also examined.

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

Elements of computer graphics in technical physics

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

Short description of discipline
Physics discipline studies the use of modern computer-aided design systems; effective use of graphic editors. Colour palette; features and setting parameters CorelDraw, AutoCAD and Visio; working with graphics and text; basic concepts of three-dimensional graphics; formats of graphic data; peculiarities of setting parameters and studying the interface and setting parameters of vector graphic 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 Elements of Machine Graphics and Basics of CAD in Technical Physics discipline forms the students of the use of computer technology in thermal technology; general information about application software, mathematical packages, MathCAD system; computer graphics, basic representations of graphic data their formats; peculiarities of AutoCAD, setting of parameters, work with graphics, text, study of interface and setting of parameters of vector graphic 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

Nuclear physics

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

Short description of discipline

The objective of 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 industrial activities. Subject, goals and objectives; their place and importance 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 Introduction to Medical Physics discipline studies and assimilates the devices and work 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 basis of the application of sound and ultrasound in medicine, the process of transfer 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

Molecular Physics and Thermodynamics

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

Short description of discipline
The Molecular Physics and Thermodynamics discipline contains the three beginnings of thermodynamics; the basic equation of state of an ideal gas; heat engines and their efficiency; transfer phenomena (diffusion, heat conduction, internal friction); isoprocesses; gases, liquids and solids, their changes due to 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
The Applied Thermophysics discipline 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 development of techniques and skills for conducting experimental and scientific experiments; when solving physical problems of specific technological and practical applications, 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 Statistical Physics and Thermodynamics discipline of contains all the beginnings of thermodynamics; temperature and entropy when microcanonical, canonical or greater canonical distributions can be applied; the quantum distributions of Fermi-Dirac, Bose-Enstein and Planck as well as the classical distributions of Maxwell and Boltzmann; the probabilistic approach does not lie in the nature of things as in quantum theory but is related to the impossibility of describing systems in detail.
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

Neutron transport theory

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

Short description of discipline
The Theory of Neutron Transfer discipline forms the student`s ideas about the methods of their theoretical understanding and experimental observation and theoretical foundations of neutron transfer; the concepts of neutron gas temperature; scattering law; neutron scattering on a fixed nucleus; neutron diffusion; neutron slowing down in infinite media; neutron thermalization; spatial distribution of slowing down neutrons; continuous slowing down 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

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

Heat-and-Mass Transfer discipline's objective is obtaining a broad knowledge by students of the fundamental laws, regularities and methods of analysis and calculation of heat and mass transfer processes. Stationary heat conduction. Unsteady heat conduction. Heat transfer by radiation. Convective heat transfer in a homogeneous medium. Forced and natural convection. Similarity of heat exchange phenomena. In the processes of heat exchange during phase transformations. In the processes of mass transfer and thermal calculation of heat exchange 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

Heat-and-Mass Transfer in Processes and Apparatuses of Heat Technologies discipline's objective is obtaining knowledge by students in the field of the basics of calculation of heat exchange apparatuses, heat and mass transfer, the theory of heat transfer. Methods of similarity and dimensionality. Heat and mass transfer in furnaces. Qualitative theory for estimation of heat transfer coefficient in forced and free convection. Heat exchange in drying plants. Methods of heat transfer intensification. Types. Efficiency of heat exchanger. 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

Chemical Thermodynamics discipline studies the application of modern methods of analysis and calculation of thermodynamic processes, and cycles of thermodynamics methods and to analyze physical and chemical phenomena. Also chemical equilibrium. 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

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 is to acquire skills for processes in nuclear and thermonuclear reactors and solving problems for various processes and studying elements of quantum mechanics, proton-neutron model of the nucleus, neutron binding energy, nuclear forces, radioactive nuclei, energy schemes of nuclear reaction, neutron physics, neutron source reactor, basic regularities of interaction of neutrons with nuclei in different energy regions, thermal neutron spectrum.

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

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; outlines the concepts, issues and provisions related to atomic physics; the decisive experiments and hypotheses that led to the formation of modern physics; spectrum of atoms energy discreteness; nuclear model of atom; quantum properties of radiation; Bohr`s theory; basic provisions of quantum theory of atoms and atomic particles; quantum physics of multi-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

Elementaric particle Physics

Postrequisites
Quantum mechanics

Applied physics and radiation safety

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

Short description of discipline
Applied Physics and Radiation Safety discipline studies radioactivity, radiation interactions with matter, biological effects of radiation, and dosimetry. The theoretical basis of the existing methods of measuring radiation dose and activity is based on studying the mechanism of interaction of various types of ionizing radiation with matter. Methods of dosimetry and protection, where radioactive substances are used in particular and in nuclear power 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
NPP Safety Principles discipline studies the analysis of the largest accidents at NPPs, rules and regulations of radiation safety, storage and managing of radioactive waste and spent fuel, probabilistic analysis of safety, regulatory documents of the RK in the field of atomic energy utilization on quality assurance and safety culture, principle of defense in depth, deterministic approach to safety assurance, 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
Radioecology and Radiation Safety discipline studies the processes of dosimetry of ionizing radiation, radiation transformation of nuclei and issues related to the formation of natural and anthropogenic radiation background, the main factors that give the problems of radiation safety the character of a global problem, formation of radiation background, dosimetry of ionizing radiations, the main natural

and artificial radionuclides significant for radioecology, weighting coefficients for separate types of radiation when calculating the equivalent dose.

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

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; methods of registration and measurement methods classification of spectral methods by type of studied transitions; technique and instruments of spectroscopy characteristics of spectral lines; features of molecular and atomic spectra of spectroscopy instrumentation; photoelectric methods, photoregistration, visual registration of spectra; methods of experimental stationary spectroscopy; luminescence, 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

Quantum mechanics

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 of 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. Interaction superfine; interaction of quantum system with radiation; X-ray spectra; multi-electron atoms; orbital interaction – Spin; simplest motions of microparticles; 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
Elementaric particle Physics
Postrequisites
Quantum mechanics

Physics of the condensed state

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

Short description of discipline
The Condensed State Physics course contains Frelich polaron; acoustic and optical phonons, plasmons, Frenkel and Vanier excitons; interaction of light with crystal lattice, polaritons; condensation of bosons; kinetic properties of dielectrics, metals and semiconductors; brillouon zone, energy zones; born-Ehrenfest adiabatic principl; non-equilibrium electrons and holes; state of electrons in the crystal lattice. Impurities and impurity levels; charge carrier scattering, conduction; 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 Physics of Semiconductors and Dielectrics course 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 Solid State Physics course contains structure of crystalline solids; structure and symmetry of solids. Inverse 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

Air conditioning and ventilation

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

Short description of discipline
The Air Conditioning and Ventilation discipline studies air purification devices, air distribution systems, calculation and selection of air ducts, fans, calculation of system performance, microclimate, thermal and humidity balances of air-conditioned rooms, heat exchangers for heat and humidity treatment of air, devices for contact type of heat and humidity treatment of air, and for regulating the amount of air, the main parameters 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
Fluid Dynamics

Postrequisites
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 Non-conventional and Renewable Energy Sources discipline studies meeting the human needs of unconventional energy sources; wind power plants; the physical basis of solar energy conversion processes using solar energy; utilization of agricultural and production waste, and the possibility of using them as primary sources for generating heat and electric energy; geothermal energy, the thermal mode 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
Basics of Alternative Energy

Postrequisites
Final examination

Chillers

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

Short description of discipline
The Refrigerating Machines discipline studies the theory of refrigerating machines and the structures of their elements in general, working processes, properties of working substances of low-temperature systems, cycles of gas refrigerating machines, absorption, steam compression and heat pumps, performance characteristics of compressors; dynamics of reciprocating machines; methods of thermal and gas dynamic calculation of the main types of devices, capacitors, vaporizers; classification of gas refrigerating 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
Thermodynamics

Postrequisites
Refrigerators

Energyequipment NEI

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

Short description of discipline
The objective of the NPU Power Equipment discipline is the devices and elements of nuclear power plants, as well as characteristics of technological circuits of NPP, thermal circuits of nuclear power units, power cycles of plants and efficiency coefficients, steam and gas turbines, pumps and gas blowers, working fluids and coolants, heat exchangers and steam generators, constructive schemes 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
Elementaric particle Physics

Postrequisites
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 deals with the basic numerical methods of quantum simulation: Monte Carlo method and exact diagonalization method; wave functions of adequate discrete basis method selection, finding correlation functions and spectrum of systems described by the main types of quantum statistics -Fermi, Bose and spin; the problems of thermodynamic temperature characteristics and numerical analysis of various systems are investigated; the correlated states in modern models of physics: spin Bose-Hubbard models, 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
Theoretical Foundations of spectrometry
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
Within Information Technologies and Engineering in Engineering Education discipline students should master the use of modern technology and engineering in engineering education, modern information technologies in engineering education based on the development of computer tools, application of modern multimedia learning tools and methods of their mastering, distance systems in education, innovative technologies in realization 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

Quantum mechanics

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

Short description of discipline
This discipline studies the principles of the foundations of quantum mechanics, the foundations of quantum mechanics in experiments, the simplest application of the Schrödinger equation, the mathematical apparatus of quantum mechanics, the theory of representations, the formulation of the matrix of quantum mechanics, the theory of angular momentum of quantum mechanics, in a centrally symmetric field the motion of bodies, approximate methods of quantum mechanics, from identical particles the foundations of the theory of systems, 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
Theoretical Foundations of spectrometry
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 an outline of the basic principles that underlie modern quantum chemistry; the basic positions and approximations applied to study the electronic and spatial structure of molecules are formulated; an idea of point symmetry groups and methods of solving applied problems of quantum chemistry using group theory methods are given; modern methods used to calculate various physical and chemical properties of molecules are described.
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
Theoretical Foundations of spectrometry
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
Within Fundamentals of Modern Energy in English discipline students should master the basics of energy production and transportation in English, as well as have a general idea of energy, features of devices and operation of power plants, theoretical foundations of the processes accompanying the production of electricity, interaction of energy facilities with the environment, indicators of thermal and overall 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

Basics of Heat Transformation

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

Short description of discipline
The Fundamentals of Heat Transformation discipline studies vapor-liquid compression heat transformers (refrigeration and heat pump installations), thermodynamic bases of heat transformation processes, operation of vapor-liquid compression heat transformers under non-calculating conditions, blower and expansion machines of heat transformers their energy characteristics, jet heat transformers, absorption heat transformers, 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 Introduction to Specialty Thermodynamics Heat and Mass Transfer Alternative and renewable energy sources Basics of Alternative Energy History of the development of energy
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 Heat Pumps discipline studies the prospects for the use of heat pump installations, sources of low-potential heat, indicators and analysis of energy efficiency of different types of heat pumps, classification of heat pump installations, schemes and principles of operation of heat pump installations, heat supply systems with heat pumps, individual heat supply, in systems of centralized heat supply and industry application of heat pumps, commercially 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
Thermodynamics Heat and Mass Transfer
Postrequisites
Basic and profile disciplines of the EP Final examination

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 Heat-and-mass Transfer in Power Plants discipline 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 in stationary processes, heat conduction non-stationary processes, convective heat transfer, diffusion processes, heat transfer by condensation and boiling, heat exchange by radiation, complex heat exchange, heat exchangers in power plants, heat-transfer fluids, 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
Thermodynamics Heat and Mass Transfer
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
Within the Formation of Technical Thesaurus discipline students should form professionally significant skills and qualities necessary for effective development and creation of terminological lexicon of thesaurus type on a particular topic, problem, field of knowledge as an information basis and means of quality oral and written translation of scientific and technical texts in the exchange between 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
Final examination

Basics cryosystems

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

Short description of discipline
The Fundamentals of Cryosystems discipline studies ideas about the areas of implementation of low- temperature processes and peculiarities of behavior of substances at low temperatures, gas and vapor-compression refrigeration machines, reverse thermodynamic cycles, thermomechanical effects, throttling of compressed gas, Joule-Thompson effect, isoentropic expansion of gas, differential and integral choke effects, desorption cooling, cooling by vapor pumping, refrigerators of He3-He4 dissolution.
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
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 Processes and Apparatuses of Gas Cooling discipline studies liquefaction of gases, characteristics of air-cooling apparatus (AHE), transportation and storage of cooled and liquefied gases, theoretical basis of calculation of heat exchangers, joint operation of AHE and gas pipeline, regasification of liquefied gases, their use in technological installations, apparatuses and technologie, 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

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 Thermophysical Processes in Cryogenic Systems discipline studies in heated channel transient processes;cooled rod axial heat conduction; in cryogenic pipelines thermal-hydraulic processes; transient processes in pipelines; unsteady processes in insulation; in cryo-tanks thermophysical processes; cooling of cryofluids; gasification of cryofluids; in low-temperature insulation heat transfer; insulation technology; in unsteady thermal-hydraulic processes physical and mathematical models; basic equations of flow.

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

Postrequisites
Basic and profile disciplines of the EP 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 Refrigeration Units discipline studies rational design of refrigeration units with the development of modern refrigeration systems, types of refrigeration units in the food and other industries, cooling methods, schemes and cycles of refrigeration units; the scope and properties of coolants; calculation and selection of basic and auxiliary equipment, types of refrigeration units according to their characteristics, 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 Nuclear Research Reactors discipline studies the physical foundations of design; physical features of NRR; classification of NRR; the physics of some NRR; experimental setups of materials testing reactors; features of heat transfer and hydrodynamics of NRR; loop installations; construction and technological schemes; trends in the development of NRR; nuclear research reactors play an important role 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
Energyequipment NEI Elementaric particle Physics
Postrequisites
Basic and profile disciplines of the EP Final examination ACS processes NPI

Specifications and technical documentation on labor protection

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

Short description of discipline
The Regulatory Technical Documentation on Labor Safety discipline considers the documentation in the preparation of plans of measures for labor protection; legal basis for the regulation of relations in the field of labor protection between employers and employees; state regulatory requirements for labor protection; regulatory documentation of the labor protection service; documents on accounting and reporting 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 the Occupational Safety and Health discipline is legal and organizational issues of labor protection. It also considers legal and organizational bases of labor protection; the basic concept and subject of labor protection; occupational hygiene and industrial sanitation, basics of physiology, fire safety, legal, socio-economic, therapeutic and preventive, sanitary and hygienic, means of protection and safety devices, organizational and 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

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 extends the knowledge of students on spectrometry of radiation on the basic concepts of radiometry, spectrometry and dosimetry of nuclear radiation, as well as methods of recording of radiation using semiconductor, scintillation, and gas-discharge detectors, characteristics of registration systems; methods of mass spectrometry; problems of spectra acquisition and registration. 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

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 Physics of Radiation Protection course is a course that deals with the impact of ionizing radiation on man and environment; methods of calculation of 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 radiation safety system at NPPs.

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

Automation of refrigeration

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

Short description of discipline

The study of the Automation of Refrigeration Units discipline by students are devices, principles of operation of basic automation tools, the basics of automatic control and regulation of the operation of a refrigeration unit, and air conditioning systems; regulation of the operation and parameters of refrigerating machines and installations; setting the boiling point in the evaporator of refrigerating machines; automation of refrigeration machines and installations; construction of characteristics of a refrigerating machine; smooth and stepwise (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

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 ICS of Technological Processes of NPU discipline studies emergency protection and alarm systems, types of emergency situations and basic signals, protection by power level and acceleration period, emergency and warning alarms; reactor power regulation; the main elements and their characteristics, the classification of management systems of the automatic control system; reactor power control and power distribution system description of the reactor as a management 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
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 Installation, Diagnostics and Repair of Refrigeration Equipment discipline gives an idea during 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
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 Fundamentals of Calculation and Design of Refrigerating Machines with CAD Elements discipline provides skills in performing computational and research work on design based on CAD tools and the design and calculation of typical elements of modern refrigerating machines; heat exchangers of the "mixing–mixing", "mixing–displacement", "displacement–displacement" types and their mathematical models; general calculation methods of reciprocating compressors; the main structural 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

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

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 Fundamentals of Technology for the Production of Artificial Cold Consumers discipline is studied in obtaining theoretical knowledge in the field of artificial cold application, drying, cooling, desorption, absorption, condensation, rectification, crystallization, adsorption, freeze drying; technological processes of chemical and food production and their classification; the composition and properties of chemicals and food products; patterns of chemical and 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 Fundamentals of Reactor Physics discipline introduces students to a number of ideas, models and concepts used in nuclear reactor physics. It is also devoted to the methods of experimental research 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 coefficient; classification of experiments; neutron- physical 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

Elementaric particle Physics

Postrequisites

Final examination

Radiometry

Discipline cycle	Profiling discipline
Course	4
Credits count	5

Knowledge control form	Examination

Short description of discipline
The Radiometry discipline aims to familiarize students with the physical basis of the interaction of radiation with matter, the ways of their registration; with the basics of radiometry methods, their capabilities and solved problems; brief characterization of the properties of radioactive radiations; theoretical foundations of radiometry; classification of radiometric measurement methods; methods of radiometric measurements; semiconductor counters; optical methods; radiography method; basics 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

Controlled thermonuclear fusion

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

Short description of discipline
The Controlled Thermonuclear Fusion discipline gives an idea of thermonuclear fusion, the physical properties of plasma, and the energy of the future; the binding energy of the nuclei; division and synthesis; high-temperature plasma; Tokamak type installations; Big ITER: parameter estimation; engineering issues of creating magnetic field windings of a tokamak; plasma equilibrium; the Grada-Shafranov equation; ohmic heating of plasma; electromagnetic tokamak system; a toroidal magnetic system; a thermonuclear energy 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
Energyequipment NEI

Postrequisites
Final examination

Nuclear fuel cycle

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

Short description of discipline
The Nuclear Fuel Cycle discipline studies the provision of 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 energy and public opinion; the impact of a nuclear power plant on the environment; fuel management: radioactive waste, problems of their neutralization and burial, 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
Undergraduate practice is a purposeful and active work of the student to collect the necessary materials for the completion of the graduation project, obtaining and consolidating the skills of design and technological design. The final stage of preparing a student for the implementation and defense of a graduation project using the experience and knowledge gained in the course of studying theoretical courses and passing industrial practices, with the fulfillment of the goals and objectives.

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