CATALOG OF ELECTIVE DISCIPLINES

7M07 - Engineering, Manufacturing and Civil engineering
(Code and classification of the field of education)

7M071 - Engineering and engineering trades
(Code and classification of the direction of training)

0710
(Code in the International Standard Classification of Education)

M098 - Heat Power Engineering
(Code and classification of the educational program group)

7M07101 - Heat Power Engineering
(Code and name of the educational program)

Master
(Level of preparation)

set of 2023

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By the Academic Committee of the EP
The head of the AC Nurymhan G.N.
EP Manager Stepanova O.A.

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Chairman of the Academic Council Oralkanova I.A.

Basics of CAD low potential energy

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course discusses the goals and objectives of mathematical modeling of low-potential energy facilities. Frequently used methods of optimization of simulated objects, types of ideal models and the method of thermoeconomics are given. The main methods of modeling and dynamic optimization of refrigeration units and air conditioning systems are considered, taking into account seasonal changes in outdoor air temperature and the magnitude of loads. Attention is paid to computer-aided design systems.

Purpose of studying of the discipline
Development of the skill of research work in the field of refrigeration technology with the formulation and conduct of simulation experiments with models of heat and mass transfer processes occurring in heat exchangers of the refrigeration industry.

Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

Learning outcomes by discipline
- demonstrate the basics of mathematical modeling and optimization of simulated objects;
- to build mathematical models of heat exchangers of refrigeration units;
- to compare the optimal temperature modes of operation of refrigeration units.

Prerequisites
Bachelor

Postrequisites
Final examination

Scientific research methodology

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course describes in detail the methodological support of research activities. The role of the functional structure of research activity is shown. Empirical and theoretical thinking in scientific cognition is analyzed. The confirmations and refutations of theoretical schemes are formulated and substantiated. The functional features of experimental modeling are generalized. An explanation of the growth of scientific knowledge is given. The importance of functional and procedural characteristics of hypotheses and their scientific novelty is shown.

Purpose of studying of the discipline
To form in students the principles and methods of organizing scientific research.

Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

Learning outcomes by discipline
- apply general scientific research methods;
- analyze research results;
- formulate results of scientific research.

Prerequisites
Bachelor

Postrequisites
Final examination

Organization and planning of scientific research

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course is devoted to the organization and planning of scientific research. The methodological foundations of scientific knowledge and creativity are outlined. The choice of the direction of scientific research and the development of stages of research work are highlighted.

The requirements for the search, accumulation and processing of scientific information are considered. The principles of theoretical and experimental research are described. Modeling in scientific and technical creativity has been analyzed. The methods of processing the results of experimental studies are generalized. The requirements for the design of the results of scientific work are formulated.

Purpose of studying of the discipline
Development of elements of research methodology for the development of creative thinking and rational organization of optimal mental activity.

Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

Learning outcomes by discipline
- describes the methodology and methodology of scientific research;

- defends the formulated goal, objectives and conclusions of scientific research;
- compares the results of experiments with theoretical assumptions;
- uses various methods for processing measurement results and estimating errors.

Prerequisites
Bachelor

Postrequisites
Final examination

Basic scientific research

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course covers the organization of research work. The fundamentals of the methodology of scientific cognition are presented. The role of choosing the direction of research is noted, and the development of all stages of scientific research is described separately. The basics of work in the search, collection and processing of scientific and technical information are formulated. The classification of research methods is carried out. Attention is paid to the correct design and implementation of the results of the conducted research. The effectiveness of the organization of work in the scientific team is summarized.

Purpose of studying of the discipline
The preparation for scientific and technological, organizational and methodological activities related to scientific research.

Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

Learning outcomes by discipline
- evaluate the level of novelty of the study;
- to plan an experiment;
- strupping oral and written speech.

Prerequisites
Bachelor

Postrequisites
Final examination

Information systems in heat power engineering and thermo technologies

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course discusses the types of models and types of modeling. The issues of mathematical modeling of heat and mass transfer processes are analyzed in detail. The applicability of numerical methods in solving heat engineering problems and mathematical modeling and optimization of heat and mass transfer devices is studied. The features of mathematical modeling of heat technology installations and optimization of heat and power supply systems of industrial enterprises are discussed. The possibilities of application software packages for automation of the scientific research system are considered.

Purpose of studying of the discipline
Formation at undergraduates knowledge and skills of computer technology, methods of modeling and optimization of thermal power and thermal technological processes, plants and systems.

Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

Learning outcomes by discipline
- interpret the main types of classification of modeling methods, the basics of using computer technology to implement mathematical models;
- apply mathematical application software packages;
- use methods for solving heat transfer problems using computer technology.

Prerequisites
Bachelor

Postrequisites
Final examination

DBMS

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course is dedicated to the field of application of databases. The basic concepts and data models are considered. The process and approaches of database design are analyzed. The creation and adjustment of the database is discussed. The principle of searching and ordering information stored in databases is given. The methods of output and analysis of information stored in databases are given. The technology of programming in a database management system is being studied.

Purpose of studying of the discipline
Mastering the basics of database theory, modern methods of database design, database design tools, familiarization with new directions with database technology.
Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.
Learning outcomes by discipline
- apply the basic principles that underlie modern database management systems;
- use computer programs that implement work with databases;
- analyze the main trends in the development of information technologies in the field of databases.

Prerequisites
Bachelor
Postrequisites
Final examination

Theory and Techniques of a scientific experiment

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course discusses in detail the methods of experiment planning. The possibilities of using single-factor, fractional factor and full factor experiments and rotatable plans in research are being studied. Optimization problems in extreme experiments are shown. Special measurement questions, error theory, mathematical statistics, probability theory and measuring instruments are considered. Methods and means of thermal measurements, thermal analysis, methods of experimental study of heat and mass transfer processes are generalized.
Purpose of studying of the discipline
Building knowledge and skills in the field of modern methods and means of scientific and industrial experiments
Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.
Learning outcomes by discipline
- explain the role of technical measurements and experimental studies in the development of science and technology;
- to draw up measuring schemes in accordance with the objectives of the research;
- choose measurement tools based on the analysis of the requirements for the accuracy of experimental results;
- to search for optimal conditions for conducting experiments;
- Take the number and condition for the experiments necessary to achieve the goal.
Prerequisites
Bachelor
Postrequisites
Final examination

Theory and technique of heating experiment

Discipline cycle	Basic disciplines
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course examines the elements of the theory of experimental planning, regression and static analysis. An overview of technical measurements and devices is given. The methods of experimental study of thermophysical properties of substances and processes of heat and mass transfer, methods and means of control of technical materials and metals of thermal power thermal technology installations are generalized. Methods of quality control of raw materials, fuels and products of heat-technological productions and metrological support of production and experimental research are presented.
Purpose of studying of the discipline
Mastering the basics of metrology and measurement technology, the formation of knowledge and skills in the field of modern methods and means of scientific and industrial experiments in the field of power and heat.
Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.
Learning outcomes by discipline
- apply the methods and means of heat engineering research within the framework of the educational program;
- to draw up a plan of experimental research;
- draw up measuring schemes in accordance with the objectives of the research.
Prerequisites
Bachelor
Postrequisites
Final examination

Experimental methods of physics research

Discipline cycle	Basic disciplines
Course	1

Credits count	5
Knowledge control form	Examination

Short description of discipline
This course discusses methods for creating and controlling pressures and temperatures during research and sources of electromagnetic and corpuscular radiation. Luminescent, resonant, electron-probe and ion-probe research methods are analyzed in detail. Methods of X-ray photoelectron spectroscopy (XPS), methods of surface investigation and X-ray diffraction studies are considered. The principle of operation and calibration of atomic power, scanning and transmission microscopy equipment is studied.

Purpose of studying of the discipline
Formation of theoretical and practical foundations of methods for studying the physical properties and characteristics of solids.

Learning Outcomes
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

Learning outcomes by discipline
ON2 To form the strategy and structure of the organization of scientific research and mathematical modeling of thermal power facilities.

- use physical and technological equipment for various purposes;
- use the principles of implementation and quality control of research objects;
- choose the methodology and the object of the study.

Prerequisites
Bachelor

Postrequisites
Final examination

Alternative energy sources

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course analyzes the harmful effects on the environment during energy production. Solar and wind energy, small and micro-hydroelectric power plants are considered. The principle of operation of heat pump and bioenergy installations is studied. The types and main indicators of alternative fuels are discussed. The analysis of the state and prospects of using alternative fuels for vehicles is given. The main directions of the use of secondary energy resources are analyzed.

Purpose of studying of the discipline
Formation of principles for the use of alternative types of energy and methods of accumulation, in order to reduce the cost of energy consumed from traditional sources.

Learning Outcomes
ON5 To evaluate traditional and non-traditional energy conversion methods.

Learning outcomes by discipline
- classify the main alternative energy sources;
- explain the principles of the processes of obtaining finite energy types from non-traditional and renewable energy sources;
- to draw up schematic diagrams of installations using alternative energy sources.

Prerequisites
Bachelor

Postrequisites
Final examination

Basics of cogeneration

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
In this discipline, cogeneration plants and prospects for their use are considered. Power units based on gas piston engines (GPE), gas turbine, combined-cycle, solid fuel and biogas cogeneration plants are considered. The issues of cogeneration and small-scale energy at food industry and agriculture enterprises are considered. The idea of trigeneration and environmental problems in the production of thermal and electrical energy is given.

Purpose of studying of the discipline
Formation of knowledge of the basics of design, installation and operation of cogeneration plants.

Learning Outcomes
ON3 To operate with the necessary calculation methods of cogeneration and ventilation heat technology plants.

Learning outcomes by discipline
- to interpret the theoretical foundations of cogeneration;
- choose a suitable cogeneration unit;
- apply methods for calculating and operating cogeneration installations.

Prerequisites
Bachelor

Postrequisites

Final examination

Modern methods of energy conversion

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This discipline is devoted to the problem of obtaining and converting energy. Primary energy resources, mechanical, electrical, electromagnetic, chemical, nuclear energy, gravitational forces, power and flow energy are considered. An idea is given about the methods of heat energy transfer and the efficiency of a thermal piston engine. The complex use of thermal and electrical energy, problems of electromagnetic energy conversion, electrochemical energy storage and nuclear power plant are considered.

Purpose of studying of the discipline
Creation of knowledge bases of the problem of obtaining, transformation, transmission and energy storage.

Learning Outcomes
ON5 To evaluate traditional and non-traditional energy conversion methods.

Learning outcomes by discipline
- explain the physical foundations of modern methods for obtaining electrical and thermal energy;
- disclose the advantages and disadvantages of various ways to produce heat and electrical energy;
- demonstrates knowledge of the methods of calculating energy equipment.

Prerequisites
Bachelor

Postrequisites
Final examination

High temperature thermal technological installation

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course is devoted to the main types of industrial thermal and low-temperature processes, devices and installations. The issues of the physical nature of processes, characteristics of heat carriers and their features, regenerative and regenerative heat exchangers and heat technology reactors are considered. The features of mixing heat and mass transfer devices and installations are studied. The gasification of solid fuels, cracking and conversion of natural gas are being analyzed. Approaches to reducing energy consumption for the implementation of high-temperature heat-technological processes are discussed.

Purpose of studying of the discipline
Formation of special skills in the design, operation and research of high–temperature thermal engineering installations - one of the most capacious consumers of fuel and other energy resources in industry.

Learning Outcomes
ON6 To develop schemes for modern heat and nanotechnology plants.

Learning outcomes by discipline
- describe structural, technological and thermal schemes of high-temperature heat technology;
- apply the methods of formation and analysis of material and thermal balances of high-temperature heat engineering plants;
- choose ways and means for conducting energy-saving events.

Prerequisites
Bachelor

Postrequisites
Final examination

Basics of nanotechnology

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course is devoted to the development trends of nanotechnology. Molecular beam epitaxy and chemical deposition from the gaseous phase are considered. Modern methods using scanning probes and scanning tunneling microscopy are given. Atomic force microscopy and atomic engineering are being studied. Probe methods for the formation of nanostructures and methods for the formation of nanoscale images are discussed. The features of self-regulating processes and the formation of nanostructured materials and coatings are analyzed in detail.

Purpose of studying of the discipline
Familiarization with the basic physical phenomena studied by nanotechnologies with the elements of the mathematical apparatus used by them.

Learning Outcomes
ON6 To develop schemes for modern heat and nanotechnology plants.

Learning outcomes by discipline
- to interpret the main trends in the development of nanotechnology; describe the main methods using scanning probes;

- use the general laws of nanotechnologies to obtain private laws; solve applied tasks;
- apply the general laws of nanotechnology when solving applied tasks.

Prerequisites
Bachelor

Postrequisites
Final examination

Industrial ventilation

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course discusses the theoretical issues of ventilation. The classification of ventilation systems, the processes of changing the state of the air and its properties are given. The thermal regime of the premises is given. Harmful substances, explosive gases and vapors are described. The basics of the aerodynamics of the organization and calculation of air exchange in the room are given. Devices for heating and cleaning ventilation air, aeration of rooms, air curtains and the basics of air conditioning are being studied

Purpose of studying of the discipline
The theoretical and practical training in the theory and practice of applied aerodynamics and thermal physics, ventilation and air conditioning, the basis of calculation, design, installation manual ventilation.

Learning Outcomes
ON3 To operate with the necessary calculation methods of cogeneration and ventilation heat technology plants.

Learning outcomes by discipline
- to interpret the theoretical foundations of ventilation technology;
- to make the equation of the air balance in the room and the equation of the balances of harmful emissions in the premises;
- use the methods of testing and operation of ventilation systems.

Prerequisites
Bachelor

Postrequisites
Final examination

Measurement of thermophysical properties of materials

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This discipline is devoted to the determination of thermophysical properties of materials. It discusses modern methods of studying thermophysical properties, experimental and theoretical methods. Methods of processing experimental studies to determine the thermophysical properties of materials are given. Experimental means and equipment for determining the thermophysical properties of various materials are being studied. The methods and analysis of error determination in the study of thermophysical properties of various materials are given.

Purpose of studying of the discipline
To generate knowledge about the mechanical, thermal, electrical, magnetic, and optical properties of materials to teach methods of thermo physical characteristics.

Learning Outcomes
ON7 To consider the thermophysics of phase transformations and material properties.

Learning outcomes by discipline
- explain physical phenomena that underlie the methods of research and control of the composition, structures and properties of materials;
- apply methods of direct and indirect measurements, as well as methods of processing results;
- analyze the practical possibilities of methods and used equipment in the study and control of the composition, structure and properties of materials.

Prerequisites
Bachelor

Postrequisites
Final examination

Methods of thermal calculation

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course discusses in detail the methods of conducting and equipping a thermophysical experiment, rules and methods for monitoring and measuring thermophysical and thermal parameters and properties. Stationary and non- stationary methods of determination and calculation of thermophysical characteristics and heat exchange processes are studied in detail. Non- destructive

methods for studying the thermophysical characteristics of materials are analyzed and discussed. The method of calculating the absolute and relative error is given.

Purpose of studying of the discipline

Formation of an idea about the methods of conducting and equipping a thermophysical experiment, rules and methods for monitoring and measuring thermophysical and thermal parameters and properties.

Learning Outcomes

ON3 To operate with the necessary calculation methods of cogeneration and ventilation heat technology plants.

Learning outcomes by discipline

- state the principles and methods for measuring the thermophysical parameters;
- choose a method for analyzing the dynamic and static properties of a given system;
- classify methods for compiling and calculating measuring circuits.

Prerequisites

Bachelor

Postrequisites

Final examination

Phase transformations

Discipline cycle	Profiling discipline
Course	1
Credits count	5
Knowledge control form	Examination

Short description of discipline

This discipline is devoted to condensed systems. It gives the thermodynamics of phases and phase transitions in binary systems and considers the structure of condensed media. The issues of the statistical theory of phase transformations in binary solid solutions and the classification of phase transitions are analyzed. Model theories of phase transformations and phase transformations in the solid state are given. Experimental methods for studying phase transitions in condensed media are being studied.

Purpose of studying of the discipline

Formation of systematized ideas about various types of structural-phase transformations and patterns that determine the structure and properties of materials depending on their composition and processing conditions.

Learning Outcomes

ON7 To consider the thermophysics of phase transformations and material properties.

Learning outcomes by discipline

- classify the main types of phase transitions;
- apply the principles of thermodynamic and statistical descriptions of phase transitions;
- evaluate the methods of research of phase transitions.

Prerequisites

Bachelor

Postrequisites

Final examination

Methods of measurement of ionizing radiation and the properties of nuclear materials

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

This course examines the categories of nuclear materials (NM) and the requirements for the accuracy and multiplicity of measurements. The balance of nuclear materials and the balance equation are considered. Accounting and confirming measurements of nuclear materials, non-destructive methods of nuclear materials analysis and calibration of the measuring system are given. Determination of the content of wells in samples by measuring their own gamma radiation and gamma spectrometric measurements is discussed. The fundamentals of the theory of radiation transfer and multiple scattering are given.

Purpose of studying of the discipline

Formation of knowledge and skills within the framework of the state system of accounting and control of nuclear materials.

Learning Outcomes

ON8 To justify methods for measuring emissions and material properties for modern nuclear energy.

Learning outcomes by discipline

- use methods for measuring nuclear materials and ionizing radiation fields;
- implement projects in the use of nuclear materials;
- analyze radiation risks and scenarios potentially possible accidents.

Prerequisites

Bachelor

Postrequisites

Final examination

Fundamentals of radiation safety

Discipline cycle	Profiling discipline
Course	2

Credits count	5
Knowledge control form	Examination

Short description of discipline
This course discusses the general concepts of radioactivity and the issues of ionizing radiation dosimetry. Methods and devices of radiation control and issues of interaction of radioactive radiation with biological objects are studied. Sources of radioactive pollution of the environment and methods of protection against ionizing radiation are given. The aspects of radiation safety when working with ionizing radiation sources are discussed. Electromagnetic radiation and legal aspects of radiation safety are analyzed.

Purpose of studying of the discipline
Theoretical and practical training on radiation safety, ensuring safe operation with ionizing radiation sources, their dosimetry and control.

Learning Outcomes
ON4 To develop measures for safe operation and research on modern NPPs, engineering networks and equipment.

Learning outcomes by discipline
- compare natural and man-made sources of radioactive pollution of the environment, mechanisms of interaction of ionizing radiation with biological objects;
- determine the level of radiation pollution;
- evaluate the effects of electromagnetic radiation on the environment.

Prerequisites
Bachelor

Postrequisites
Final examination

Modern ways of development of nuclear energy

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
In this course, nuclear fuel and heat carriers and the physical basis of obtaining thermal and electrical energy are considered. General information about the history of the development of domestic and foreign nuclear power is given. The contribution of domestic and foreign scientists to the development of nuclear energy and the use of fission energy, synthesis and other energy-intensive technologies for the production of electricity is discussed. The basic concepts of physics and design of nuclear reactors are analyzed.

Purpose of studying of the discipline
Formation of knowledge on current trends of nuclear energy development.

Learning Outcomes
ON8 To justify methods for measuring emissions and material properties for modern nuclear energy.

Learning outcomes by discipline
- predict the ways of development of atomic energy;
- analyze promising areas of research in the development of nuclear power plants;
- to assess the process of production and use of atomic energy.

Prerequisites
Bachelor

Postrequisites
Final examination

Engineering systems, networks and equipment

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
This course is dedicated to engineering systems of settlements and industrial enterprises. It discusses the classification of engineering systems, water supply, sewerage systems and schemes, and solid and household waste. The issues of heat supply, gas supply, ventilation and air conditioning are being studied. Household gas installations and power supply issues are being investigated. General information on electrical safety is given. Transport, information systems, computer, radio and television networks are considered.

Purpose of studying of the discipline
Theoretical and practical preparation for work related to calculations, design, construction, manufacture, installation and operation of engineering systems.

Learning Outcomes
ON4 To develop measures for safe operation and research on modern NPPs, engineering networks and equipment.

Learning outcomes by discipline
- explain the device and the principle of operation of the main engineering systems, networks and equipment, standard schemes and designs of their elements, rules of operation and safety during maintenance;
- to determine the optimal variants of engineering systems and the rational layout of the components and equipment;
- to assess the possible negative impact of enterprises on the environment, depending on the volume of production.

Prerequisites

Bachelor

Postrequisites

Final examination

Innovative heat technologies in heat power engineering

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

This course examines thermal, waste- free technologies and thermal, technological and functional schemes in modern industrial production. Economic and environmental analyses of heat-technological processes and criteria for environmental assessment of low-waste heat technologies are given, as well as ways to increase the efficiency of energy use in existing heat-technological processes. The analysis of the effective use of energy and material resources, as well as energy consumption maps in the heat technology complex is given.

Purpose of studying of the discipline

Development of expertise in the field of energy and resource problems arising in the establishment and operation of innovative thermal technological systems.

Learning Outcomes

ON9 To develop innovations in heat and power engineering and cryogenic engineering.

Learning outcomes by discipline

- evaluate modern energy-intensive technologies and production;
- develop the technical tasks of projects for the modernization of objects and systems of thermal power engineering based on existing innovative technologies;
- analyze the results of project tasks for improving and developing effective innovative solutions in the development of heat technology processes.

Prerequisites

Bachelor

Postrequisites

Final examination

Cryogenic technique

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

In this discipline, the scope of application, physical research and properties of cryoagents are considered. The ideal cycle and cascade liquefaction, cryogenic systems with the use of throttle effect and expansion in expanders are given. Refrigeration and liquefaction systems, features of the Kapitsa and Claude cycle are considered. The process of hydrogen and helium liquefaction and air separation is considered. Microcryogenic systems and medical cryoapparation are presented.

Purpose of studying of the discipline

The study of the issues of cooling the medium to and below the level of 120 K and the study of processes and phenomena occurring in cryogenic machines and apparatuses.

Learning Outcomes

ON9 To develop innovations in heat and power engineering and cryogenic engineering.

Learning outcomes by discipline

- to interpret the mechanism of the process and phenomena occurring in cryogenic machines and apparatuses;
- describe the device and operation of the main most common designs of devices and machines used in the separation of gas mixtures by low-temperature rectification;
- to use the basic methods of calculation of cryogenic machines and devices;
- use methods for calculating the main most common processes and structures of cryogenic machinery and apparatus.

Prerequisites

Bachelor

Postrequisites

Final examination

Atomic power stations

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

This course covers energy resources and the production of electrical energy. The criteria for the selection of steam parameters at nuclear power plants with regenerative heating of feed water and water coolant are disclosed. The description of the steam generator plant of a nuclear power plant with PWPR and a reactor plant with a water coolant is given. The issues of technical water supply and layout of NPP equipment are considered. Ventilation and decontamination installations and thermal schemes are considered. Nuclear power plant.

Purpose of studying of the discipline

The theoretical and practical skills related to the choice of parameters and the type of equipment in the design and operation of nuclear power plants and AST in the power in stationary, transient and accident conditions.

Learning Outcomes

ON4 To develop measures for safe operation and research on modern NPPs, engineering networks and equipment.

Learning outcomes by discipline

- represent nuclear processes and kinetics of a nuclear reactor;
- describe the production of electrical and thermal energy in nuclear-fueled power plants;
- to carry out the calculation of thermal circuits of power plants and their main elements.

Prerequisites

Bachelor

Postrequisites

Final examination

Perspectives and heat physics problems of heat refrigerants technique

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

This course presents the theoretical foundations of obtaining low and ultra-low temperatures. An analytical description of heat transfer processes is given. Approximate methods for solving the equations of thermal conductivity and diffusion for the conditions of heat treatment of products are considered. The basic concepts and methods of calculating the processes of cooling, freezing and defrosting of products are given. Freeze drying, cold storage and heat treatment of products are considered.

Purpose of studying of the discipline

Formation of a set of concepts in the field of low-temperature technology and high-temperature production.

Learning Outcomes

ON10 To outline the problems and prospects for the development of heating and cooling equipment.

Learning outcomes by discipline

- to describe the theoretical foundations of obtaining low and ultra-low temperatures, the main problems of retaining the low-temperature potential;
- perform thermal calculations and analysis of the efficiency of heat and cooling technologies;
- to optimize the temperature and time modes of the processes of influence on various material systems.

Prerequisites

Bachelor

Postrequisites

Final examination

Using heat and gas refrigeration machines

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline

Theoretical and actual cycles of gas refrigerating machines are considered in this discipline. The design of gas refrigerating machines with expanders and gas refrigerating machines with vortex tubes is given. The main provisions of the theory of thermoelectric refrigerating machines are given. The principle of operation, theoretical and actual processes of the steam ejector machine are considered. The principle of operation of the absorption refrigerating machine and the analysis of actual processes are given.

Purpose of studying of the discipline

Formation of professional competencies in the field of design, operation and installation of machines for compression and expansion of gases.

Learning Outcomes

ON10 To outline the problems and prospects for the development of heating and cooling equipment.

Learning outcomes by discipline

- describe the basics of the theory of thermodynamic processes of compression and expansion of gases;
- perform calculations and explain the design principles of elements, assemblies and parts of refrigerating machines, as well as the principles of their aggregation and layout;
- to draw up technical specifications and analysis in order to select optimal operational parameters.

Prerequisites

Bachelor

Postrequisites

Final examination

Systems of low temperature thermal technology

Discipline cycle	Profiling discipline
Course	2

Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline is devoted to the consideration of the important role and great importance of low-temperature technology systems in various industries. The stages of development and formation of low-temperature technologies are shown. The classification of low-temperature heat technologies and the principles of constructing schemes of installations for their implementation are presented, the main and auxiliary equipment included in these schemes are described. The available methods of evaluating the efficiency and environmental friendliness of the equipment are highlighted.

Purpose of studying of the discipline
Formation of practical skills of design and operation in the field of low-temperature technology systems in various industries.

Learning Outcomes
ON9 To develop innovations in heat and power engineering and cryogenic engineering.
ON10 To outline the problems and prospects for the development of heating and cooling equipment.

Learning outcomes by discipline
- explain the features of the processes in low-temperature systems;
- to calculate the processes that occur in elements of low-temperature installations;
- analyze the basic operational requirements for installations and the possibility of implementing these requirements.

Prerequisites
Bachelor

Postrequisites
Final examination

Modern methods of processing organic fuel

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The course covers the issues of modern methods of processing organic fuels, which are either physico-mechanical or physico-chemical, and also considers their classification according to various characteristics. The characteristics of existing raw materials and the requirements that apply to raw materials are presented. The description of obtaining important and valuable products, such as coke oven gas, coke, as a result of organic fuel processing processes is given. The issues of environmental friendliness of fuel processing processes are considered.

Purpose of studying of the discipline
Formation of skills in the field of modern methods of organic fuel processing.

Learning Outcomes
ON9 To develop innovations in heat and power engineering and cryogenic engineering.
ON10 To outline the problems and prospects for the development of heating and cooling equipment.

Learning outcomes by discipline
- evaluate prospects, development paths and efficiency of organic fuel processing methods;
- justify the choice of organic fuel processing technology from the point of view of technical and economic indicators;
- use methods for developing layout schemes of equipment and technological lines for the processing of organic fuel.

Prerequisites
Bachelor

Postrequisites
Final examination

Modern technologies of use of secondary energy resources

Discipline cycle	Profiling discipline
Course	2
Credits count	5
Knowledge control form	Examination

Short description of discipline
The discipline considers various ways and directions of using secondary energy resources as a way to energy conservation. The classification of secondary energy resources and possible directions of their application are shown. The stages of development and implementation of waste-free production technology are presented. The role of modern energy-saving measures as an energy-saving potential in heat and power production is substantiated. A detailed analysis and evaluation of the effectiveness of the use of secondary energy technology in the world is given.

Purpose of studying of the discipline
Formation of the basics of the use of secondary energy resources as the main way to energy conservation.

Learning Outcomes
ON5 To evaluate traditional and non-traditional energy conversion methods.
ON9 To develop innovations in heat and power engineering and cryogenic engineering.

Learning outcomes by discipline
- to evaluate the possibility of using potential secondary energy resources;
- hold the selection and calculation of the main equipment;
- evaluate the advantages and disadvantages of using secondary energy resources.

Prerequisites
Bachelor
Postrequisites
Final examination