



Institute Energy and Mechanical engineering  
Department "Power Engineering"

**EDUCATIONAL PROGRAM**  
**6B07122 - «Heat Power Engineering»**  
the cipher and the name of the educational program

Code and classification of the field of education: **6B07 Engineering, manufacturing and construction industries**

Code and classification of training directions: **6B071 Engineering and Engineering**

Group of educational programs: **B062 Electrical Engineering and Power Engineering**

Level based on NQF: **level 6**

Level based on IQF: **level 6**

Study period: **4 years**

Amount of credits: **240 ECTS**

**Almaty 2024**

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named after K.I.SATBAYEV»



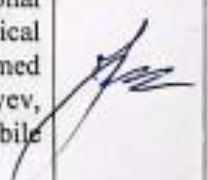

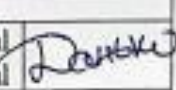
The educational program 6B07122 - "Heat power engineering" approved at a meeting of the Academic Council of the Kazakh National Research Technical University named after K.I.Satpayev

Protocol No. 12 from 22.04.2024.

Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of the KazNRTU named after K.I.Satpayev.

Protocol No. 6 from 19.04.2024.

The educational program 6B07122 - "Heat power engineering" developed by the academic committee in the direction of "Engineering and Engineering"

Full name	Academic degree/ academic title	Post	Place of work	Signature
<b>Field of study:</b> 6B071, 7M071, 8D071 "Engineering and engineering"				
<b>Chairman of the Academic Committee:</b>				
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<b>Representatives of employers:</b>				
Abdikalykov Galymzhan		General manager		
<b>Representatives of students:</b>				
Danko Igor		2nd year doctoral student	Kazakh National Research Technical	

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## **List of abbreviations and designations**

EP – educational program

BC – basic competencies

PC – professional competencies

LO – learning outcomes

MOOC – massive open online courses

NQF – National Qualifications Framework

IQF – Industry Qualifications Framework

## 1. Description of educational program

The educational program is designed to train personnel to work in production workshops and engineering departments of thermal and nuclear power plants, industrial heating boilers and enterprises of the energy, metallurgical, mining and processing, oil and gas industries and in the housing and utilities sector, as well as in production laboratories, energy and environmental expertise, environmental, energy, housing and communal services.

The direction of the specialty and specialization program covers engineering and engineering.

In case of successful completion of the full bachelor's degree course, the graduate is awarded the academic degree "Bachelor of Engineering and Technology in the field of Thermal Power Engineering".

The volume of mathematical, natural science, basic and language disciplines has been increased in the educational program. Profile disciplines have been added, which can be divided into two groups: disciplines on thermal power engineering and disciplines on alternative energy. The result was an educational program that has innovative and practical content and is aimed at implementing the Digital Kazakhstan program.

The educational program provides for the study of the following innovative disciplines:

- thermodynamic cycles of thermal machines and cooling processes - energy audit and energy saving at enterprises;
- solar installations and heat pumps;
- industrial and domestic thermal power equipment;
- hydro-gas dynamics of media in thermal power plants;
- calculation and design of heat and mass transfer equipment;
- heat supply systems of enterprises;
- heating networks and heat supply systems of enterprises and housing and communal services;
- combined-cycle and gas turbine installations of thermal power plants and nuclear power plants;
- operation of the main TPP equipment;
- heat and mass transfer equipment of the enterprise;

In the process of mastering the educational program, a bachelor of Engineering and technology in the field of thermal power engineering should have the following key competencies.

The bachelor must:

*have an idea:*

- about modern thermal power facilities, about autonomous power sources and renewable energy facilities, about promising areas of energy development;
- on modern approaches to the calculation and design of thermal power systems, as well as to the use of software tools for the management and evaluation of energy systems;

- about modern elements and installations of thermal power systems (devices, apparatuses, equipment, etc.).

*To know:*

- theoretical and experimental research methods for the purpose of creating new promising areas in the field of thermal power engineering;

- principles of operation, technical characteristics and design features of the developed and used energy facilities;

- standards, methodological and regulatory materials, fundamentals of design, installation and operation of thermal engineering installations of the thermal power industry;

- modern and promising directions of development of heat power and heat technology systems, principles of operation, technical characteristics and design features of the developed and used heat power and heat technology installations and systems;

- determine the thermodynamic properties of substances, calculate the main parameters of the cycles of heat and refrigeration machines, use tables and diagrams of the state of substances.

*be able to:*

- to develop the principles of organization and design of thermal power plants;

- use application software packages for calculations, modeling and automation of design of thermal power systems;

- use theoretical information on the organization of the technological process of heat and electricity generation at thermal power plants;

- apply methods to increase the economic efficiency of municipal heat power by using new renewable energy sources, methods for calculating heat exchangers, techniques for using heat power equipment and systems;

- to solve the main issues of heating and heat supply systems, design features of internal heat supply systems, heating networks, equipment of heating points;

- use methods for calculating heat and power supply.

- apply methods and measuring instruments used in the production and consumption of thermal and electrical energy;

- use energy- and resource-saving technologies, conduct a preliminary feasibility study of design calculations;

- to carry out calculations on the heat consumption of thermal power plants.

*have skills:*

- formulate the main technical and economic requirements for the designed heat power systems;

- organization of work on the operation, installation and commissioning of electrical and thermal equipment;

- development and design on the modern element and technical basis of energy systems and individual devices.

- possess modern methods and devices for monitoring and accounting of energy carriers.

- calculate energy losses through heat transfer, radiation, convection, and determine heat losses of various building structures.

During the training, production practices are provided at such enterprises as: NC KEGOC, JSC AZHK, JSC AIES, Almaty Thermal Networks LLP, JSC Kazatomprom, Kazzinc LLP, Karachaganak Petroleum Operating and others.

## 2. Purpose and objectives of educational program

**Purpose of EP:** The purpose of the educational program is to teach students general education, basic and specialized disciplines with the achievement of appropriate competencies. Preparation of bachelors with professional knowledge in the design, installation, operation and repair of equipment for thermal and nuclear power plants, power supply sources for industrial enterprises and settlements, who have an idea of the classical and new directions of modern energy and environmental technologies, and are able to apply the knowledge gained in scientific, practical and industrial activities.

**Tasks of EP:** Theoretical and practical training of highly qualified bachelors of heat power engineering, capable of performing tasks of the entire complex of engineering issues of heat supply, using modern computer technology and introducing new technologies in design.

## 3. Requirements for evaluating the educational program learning outcomes

Admission to the university is carried out according to the applications of an applicant who has completed secondary, secondary special education in full on a competitive basis in accordance with the points of the certificate issued according to the results of the unified national testing with a minimum score of at least 65 points.

Special requirements for admission to the program apply to graduates of 12 summer schools, colleges, applied bachelor's degree programs, niches, etc. Such applicants must pass diagnostic testing in English, mathematics, physics and special disciplines.

Rules for credit transfer for accelerated (reduced) education based on 12-year secondary, secondary technical and higher education

Code	Competence type	Description	Competence result	Responsible
Shared (Includes full training with possible additional, depending on the level of knowledge)				
G1	Communication	- Fugitive monolingual oral, written and communication skills - The ability not to	Full 4-year study with a minimum of 240 academic loans (of which 120 contact classroom academic credits)	Department of Kazakh and Russian, Department of



		<p>communi-cate fluently with a second language</p> <ul style="list-style-type: none"> <li>- The ability to use communi-cative communication in different situations</li> <li>- There are basics to acade-mic writing in their native language</li> <li>- Diagnostic language test</li> </ul>	<p>with a possible re-recording of loans in the second language where students have an advanced level. The level of language is determined by passing the diagnostic test</p>	English
G2	Mathematical Literacy	<ul style="list-style-type: none"> <li>- Basic mathematical thinking at the communication level</li> <li>- the ability to solve situational problems on the basis of the mathematical apparatus of algebra and began mathematical analysis</li> <li>- Diagnostic test for mathe-matical literacy in algebra</li> </ul>	<p>Full 4-year study with a minimum of 240 academic loans (of which 120 are contact auditory academic loans). With a positive test of diagnostic test, the level of mathematics 1, the negative - the level of algebra and the beginning of the analysis</p>	Mathematics Department
G3	Basic literacy in science disciplines	<ul style="list-style-type: none"> <li>- A basic understanding of the scientific picture of the world with an understanding of the basic laws of science</li> <li>- Understanding basic hypotheses, laws, methods, drawing conclusions and assessing errors</li> </ul>	<p>Full 4-year study with a minimum of 240 academic loans (of which 120 are contact auditory academic loans). With a positive test of diagnostic test level Physics 1, General Chemistry, at negative - the level of the Beginning of Physics and basic basics of chemistry</p>	Departments in the fields of natural sciences
<p><b>Specific</b> (includes reduced tuition by re-counting credits depending on the level of competence knowledge for graduates of 12-year schools, colleges, universities, including humanitarian and economic areas)</p>				
S1	Communication	<ul style="list-style-type: none"> <li>- Fugitive bilingual oral, written and communication skills</li> <li>- The ability not to communi-cate fluently with a third language</li> <li>- writing skills of different styles and genres</li> <li>- skills of deep understanding and interpretation of one's own work of a certain level of complexity (essay)</li> <li>- basic aesthetic and theore-tical literacy as a condition of full perception, interpretation of the original text</li> </ul>	<p>Full re-repayment of credits by language (Kazakh and Russian)</p>	Department of Kazakh and Russian
S2	Mathematical Literacy	<ul style="list-style-type: none"> <li>- Special mathematical thin-king using induction and deduction, generalization and</li> </ul>	<p>Re-credit for The Discipline of Mathematics (Calculus) I</p>	Mathematics Department

		<p>specification, analysis and synthesis, classification and systematization, abstraction and analogy</p> <ul style="list-style-type: none"> <li>- The ability to formulate, substantiate and prove positions</li> <li>- Application of common mathematical concepts, formulas and extended spatial perception for mathematical tasks</li> <li>- Full understanding of the basics of mathematical analysis</li> </ul>		
S3	Special literacy in science disciplines (Physics, Chemistry, Biology and Geography)	<ul style="list-style-type: none"> <li>- A broad scientific perception of the world that suggests an understanding of natural phenomena</li> <li>- Critical perception to understand the phenomena of the world around</li> <li>- cognitive ability to formulate a scientific understanding of the forms of existence of matter, its interaction in nature</li> </ul>	Re-credits for Physics I, General Chemistry, General Biology, Introduction to Geology, Introduction to Geodesy; Training practice, etc.	Departments in the fields of natural sciences
S4	English language	<ul style="list-style-type: none"> <li>- Readiness for further self-learning in English in various fields</li> <li>- Ready to gain experience in design and research using English</li> </ul>	Refilort English credits above academic to professional level (up to 15 credits)	Department of English
S5	Computer skills	<ul style="list-style-type: none"> <li>- Basic programming skills in one modern language</li> <li>- Use software and applications to teach different disciplines</li> </ul>	Reset Credits on Discipline Introduction to Information and Communication Technologies, Information and Communication Technologies	Department of Software Engineering
S6	Social and humanitarian competencies and behaviour	<ul style="list-style-type: none"> <li>- Understanding and understanding the responsibility of every citizen for the development of the country and the world</li> <li>- The ability to discuss ethical and moral aspects in society, culture and science</li> </ul>	Re-credit for Kazakhstan's Modern History (excluding state exam)	Department of Public Discipline
		<ul style="list-style-type: none"> <li>- Critical understanding and the ability to debate on modern scientific hypotheses and theories</li> </ul>	Re-credit credits for philosophy and other humanities	
<b>PROFESSIONAL</b> (includes reduced education by re-counting credits depending on the level of knowledge on competences for college graduates, AV schools, universities)				
P1	Professional competencies	<ul style="list-style-type: none"> <li>- Critical perception and a deep understanding of professional competencies at level 5 or 6</li> </ul>	Re-credits for basic professional disciplines, including introduction to specialty, engineering ethics,	Releasing chair

		- The ability to discuss and debate professional issues within the framework of the mastered program	robotic technology, automation technology, theoretical basics of electrical engineering, technological measurements and instruments, mathematical basics of control theory, electronic automation devices.	
P2	General Engineering Competencies	- Basic general engineering skills and knowledge, the ability to solve general engineering problems and problems - be able to use application packages to process experimental data, solve algebraic and differential equation systems	Re-credit for general engineering disciplines (engineering graphics, outline geometry, electrical engineering basics, microelectronics basics.)	Releasing chair
P3	Engineering and computer competencies	- Basic skills in using computer programs and software systems to solve general engineering problems	Re-credit for computer graphics discipline, computer modeling and programming in the MatLab environment.	Releasing chair
P4	Socio-economic competences	- Critical understanding and cognitive ability to reason on contemporary social and economic issues - A basic understanding of the economic assessment of research sites and the profitability of projects.	Re-transfer credits for socio-humanitarian and technical and economic disciplines in the set-off of the electorate cycle	Releasing chair

The university may refuse to re-borrow credits if the low diagnostic level is confirmed or the final grades were lower than A and B.

## 4. Passport of educational program

### 4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	6B07 Engineering, manufacturing and construction industries
2	Code and classification of training directions	6B071 Engineering and Engineering
3	Educational program group	B062 Electrical Engineering and Power engineering
4	Educational program name	Heat power engineering
5	Short description of educational program	The educational program is designed to train personnel to work in production workshops and engineering departments of thermal and nuclear power plants, industrial heating boilers and enterprises of the energy, metallurgical, mining and processing, oil and

		<p>gas industries and in the housing and utilities sector, as well as in production laboratories, energy and environmental expertise, environmental, energy, housing and communal services.</p> <p>The direction of the specialty and specialization program covers engineering and engineering.</p> <p>In case of successful completion of the full bachelor's degree course, the graduate is awarded the academic degree "Bachelor of Engineering and Technology in the field of Thermal Power Engineering".</p> <p>The volume of mathematical, natural science, basic and language disciplines has been increased in the educational program. Profile disciplines have been added, which can be divided into two groups: disciplines on thermal power engineering and disciplines on alternative energy. As a result, we have an educational program that has innovative and practical content and is aimed at implementing the Digital Kazakhstan program.</p>
6	Purpose of EP	<p>The purpose of the educational program is to teach students general education, basic and specialized disciplines with the achievement of relevant competencies. Theoretical and practical training of highly qualified bachelors of heat power engineering, capable of performing tasks of the entire complex of engineering issues of heat supply, using modern computer technology and introducing new technologies in design. Preparation of bachelors with professional knowledge in the design, installation, operation and repair of equipment for thermal and nuclear power plants, power supply sources for industrial enterprises and settlements, who have an idea of the classical and new directions of modern energy and environmental technologies, and are able to apply the knowledge gained in scientific, practical and industrial activities.</p>
7	Type of EP	Current
8	The level based on NQF	level 6
9	The level based on IQF	Level 6
10	Distinctive features of EP	No
11	List of competencies of educational program	<p>A - knowledge and understanding:</p> <p>A1 - methods of building electrical, technological and functional schemes for the design of Power Engineering systems;</p> <p>A2 - current trends in the development of technical and technological systems of Power Engineering facilities;</p> <p>A3 - standards, methodical and regulatory materials accompanying the operation, installation and installation of thermal power and Electric Power Engineering facilities.</p>

		<p>B - applying knowledge and understanding:  B1 - independent work and offer various options for solving professional problems using theoretical and practical knowledge;  B2 - to organize installation, installation and operation of Electric Power Engineering and thermal systems;  B3 - to organize the collection, storage and processing of information used in the field of professional activity.</p> <p>C - the formation of judgments:  C1 - about modern Power Engineering industry facilities and process management systems;  C2 - on the application of modern autonomous Power Engineering systems of different categories of consumer approaches;  C3 - about modern technical devices and technological equipment of Power Engineering facilities (devices, devices, conductors, equipment, executive mechanisms, microprocessors, etc.).</p> <p>D - personal abilities:  D1 - to be an Power Engineering engineer, electrical engineer of the production division of the operation of Power Engineering systems;  D2 - to be a specialist in the maintenance of electrical and thermal networks, and systems;  D3 - to be an engineer of the production unit for the repair of thermal and electrical installations;  D4 - to be able to organize work on setting up Power Engineering and electromechanical plants of industrial enterprises.</p> <p><b><i>Competences at the end of training</i></b>  B - Basic knowledge, skills and skills:  B1 is capable of philosophical analysis of social phenomena, personality behavior and other phenomena. I am ready to conduct a philosophical assessment of social phenomena;  B2 - to know and apply in practice the basics of engineering professional ethics;  B3 - to be able to analyze the current problems of the modern history of Kazakhstan.</p> <p>P - Professional competencies, including in accordance with the requirements of industry professional standards:  P1 is a wide range of theoretical and practical knowledge in the professional field;  P2 - is able to analyze and solve problems on the theory of electrical circuits and heat technology;</p>
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		<p>P3 - is able to analyze thermal, electrical and installation schemes of technological production. I am ready to install, set up and operate thermal and electrical installations, and systems.</p> <p>O - Human, social and ethical competences:  O1 - is able to freely use english as a means of business communication, a source of new knowledge in the field of electrical engineering and Power Engineering. I am ready to use the English language in the professional activities in the field of Electric Power Engineering and heat Power Engineering;  O2 - is able to freely master the Kazakh (Russian) language as a means of business communication, a source of new knowledge in the field of electrical engineering and Power Engineering. I am ready to use the Kazakh (Russian) language in professional activities in the field of Electric Power Engineering and heat Power Engineering;  O3 - to know and apply in work and life the basics of applied ethics and ethics of business communication;  O4 - to know and apply the basic concepts of professional ethics;  O5 - to know and apply in practice the "code of conduct of engineer";  O6 - to know and solve the problems of human influence on the environment.</p> <p>C - Special and Management Competencies:  C1 - self-management and control of work and training processes within the framework of the organization's strategy, policies and objectives, discussion of the problem, reasoning of conclusions and competent operation of information;  C2 - <i>in the field of organizational and management activities</i>: to be the head of the group of the division for the operation, installation and repair of power plants in various industries;  C3 - <i>in the field of experimental research</i>: to be a specialist in experimental research of thermal and electric power facilities;  C4 - <i>in the field of research</i>: to be an engineer of a scientific laboratory for the research and development of modern Power Engineering installations and systems in various industries;  C4 - <i>in the field of design</i>: to be an engineer in the development and design of electric power plants, and systems in various industries..</p>
12	Learning outcomes of educational program:	General standard requirements for graduation and awarding a bachelor's degree: mastering at least 240 academic credits of theoretical training and final diploma work or state exam in specialty.

		<p>Special requirements for graduating from university under this program</p> <p><i>graduate should know:</i></p> <ul style="list-style-type: none"> <li>- theoretical and experimental research methods to create promising new directions in the field of electrical engineering and Power Engineering;</li> <li>- principles of work, specifications and design features of Power Engineering products developed and used;</li> <li>- standards, methodical and regulatory materials, design, installation and operation of electrical and thermal installations of the Power Engineering industry;</li> </ul> <p><i>graduate should be able to:</i></p> <ul style="list-style-type: none"> <li>- develop the principles of the organization and design of Power Engineering companies;</li> <li>- use application packages to calculate, model and automate Power Engineering systems design;</li> <li>- to formulate the basic feasibility and economic requirements for the Power Engineering systems being projected;</li> <li>- to organize the operation, installation and installation of electrical and thermal facilities.</li> </ul> <p>Training in this OP is completed by passing the state exam in the following disciplines or protection before the GAC diploma project (work).</p>
13	Education form	Daytime
14	Period of training	4 years
15	Amount of credits	240 ECTS
16	Languages of instruction	state, Russian
17	Academic degree awarded	Bachelor of Engineering and Technology in OP "6B07122-Heat Power Engineering"
18	Developer(s) and authors:	Sarsenbaev Ye., Umyshev D., Nygymanova A.

## 4.2. The relationship between the achievability of the formed learning outcomes according to the educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)								
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	.....	.....
<b>Cycle of general education disciplines Required component</b>												
M1	Foreign language  Kazakh (Russian) language	The ability to perceive authentic material, convey the main idea, express your point of view using active vocabulary on the topic, giving reasoned arguments.  Attention is paid to linguistic competence, the development of the world language, discourse, strategy and the socio-cultural component of subjective knowledge. When teaching the Kazakh language, the peculiarities of the language and national cognitive qualities should be taken into account. The content of the discipline covers socio-cultural, social, household and educational and professional spheres.	10  10	+		<b>V</b>						
M2	Physical Culture	The discipline is aimed at students' acquisition of knowledge in the field of physical culture, the formation of a motivational and value attitude to physical culture, attitudes to a healthy lifestyle, the need for regular physical exercises, the formation of physical culture of the individual, preparation for socio-professional activities, preservation and strengthening of health.	8									
M3	Information and communication technologies	The need to study this discipline is due to the fact that students have a holistic understanding of the use of ICT in various fields of professional activity and be able to use the capabilities of modern information technologies, work with application packages,	5									



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		network and web applications. Be able to write programs for various calculations in software shells.											
M4	Modern history of Kazakhstan	This course contributes to the formation of knowledge in the field of modern understanding and study of the priorities of national history and the Concept of the formation of historical consciousness in the Republic of Kazakhstan.	5										
	Philosophy	In the course of the course "Philosophy", students will gain knowledge about the stages of philosophy development, about the specifics of Kazakh philosophical thought, get acquainted with the main problems, concepts and categories of philosophy.	5										
	Sociology	The subject of sociology as a science, basic laws, structure, functions; history of the development of sociological thought; social status of the individual, social behavior and social roles; social deviations; mass consciousness and mass actions; social stratification, social institutions, conflicts and the logic of their resolution; sociological research as a tool for cognition of society's problems, preparation and conduct of sociological research	3										
	Political Science	"Political Science" forms knowledge about the laws and laws of world politics and modern political processes, explaining the essence and content of the policy of national states, on the basis of ensuring national security and the realization of national interests. The study of this course contributes to the understanding of internal and external relations and relations, the main trends and patterns operating in various political systems, the development of objective criteria for the social dimension of politics. The purpose of teaching the course is to study the laws of the formation and											

	<p>Cultural studies</p> <p>Psychology</p>	<p>functioning of politics, prepare students to participate in the political life of the country, and form an active civic position.</p> <p>The need to teach this discipline is due to the fact that students have a holistic view of culture as a universal way of a person's attitude to the world, the most important condition for his spiritual development and to teach them to understand the theory and history of culture.</p> <p>In modern conditions of the development of society, the role of the psychological content of the management process is increasing. During the course, students will get acquainted with modern ideas about the role and multidimensional content of the psychological component of managerial activity, as well as acquire practical skills in managing the behavior of people in the organization, which they will be able to use in their future professional activities..</p>	5										
M5	<p>The basics of anti-corruption culture</p> <p>Fundamentals of Entrepreneurship and Leadership</p>	<p>The discipline studies the essence, causes, causes of sustainable development of corruption from both historical and modern points of view. Examines the prerequisites and impacts for the development of an anti-corruption culture. Studies the development of anti-corruption on the basis of social, economic, legal, cultural, moral and ethical norms. Studies the problems of the formation of an anti-corruption culture based on the relationship with various types of social relations and various manifestations.</p> <p>The discipline studies the basics of entrepreneurship and leadership from the point of view of science and law; features, problematic aspects and prospects of development; theory and practice of entrepreneurship as a</p>	5										



		of continuum mechanics. Vibrations and waves. Molecular physics and thermodynamics. Statistical physics and thermodynamics. Statistical distributions. Fundamentals of thermodynamics. Transfer phenomena. Real gases. Electricity and magnetism. Electrostatics. Constant electric current. Magnetic field. The phenomenon of electromagnetic induction.											
<b>Cycle of basic disciplines University component</b>													
M7	Materials science in thermal power engineering	When studying the discipline, students should learn, as a result of analyzing the operating conditions, to choose a material and a method for manufacturing parts and products using modern technological processes, to choose optimal methods for studying the properties and structure of materials, to determine the mechanical properties of materials, to analyze the structure of materials, to process the experimental results obtained, to analyze technical information in the field of materials science and technology of structural materials. Fundamentals of theoretical and experimental research of processes and equipment of thermal power engineering and heat engineering; theory of development of optimal engineering solutions taking into account limitations, theory of solving inventive tasks; methodology for conducting a preliminary feasibility study of design solutions; the main global trends in the development of low-waste, energy-saving and environmentally friendly resource-efficient technologies in thermal power engineering; criteria for the selection and creation of thermal power equipment.	5										

M7	Theoretical foundations of thermal engineering	Basic concepts and definitions; laws of ideal gas; mixtures of ideal gases; the first beginning of thermodynamics; the second beginning of thermodynamics; differential equations of thermodynamics; equilibrium of thermodynamic systems and phase transitions; T-S and h-S diagrams, thermodynamic processes of water and water vapor; throttling; exergetic losses; refrigeration cycles; refrigeration units; humid air; h-d-diagram of humid air; fundamentals of chemical thermodynamics thermochemistry.	5										
	Technical thermodynamics	The first and second principles of thermodynamics. Thermodynamics of ideal and real gas: properties and processes. Characteristic functions and dif. equations of thermodynamics. The third law of thermodynamics. Thermodynamics of stationary mass flow. Thermodynamics of gas and steam-gas mixtures. Thermodynamics of chemically reacting systems, fundamentals of chemical thermodynamics. Thermodynamics of steam and gas cycles. Combined cycles, cycles of steam turbine power plants and cycles of nuclear power plants.	5										
	Thermodynamic cycles of thermal machines and cooling processes  Solar Plants and heat pumps	The discipline studies thermodynamic processes occurring in heat engines. In particular, the processes of expansion and compression of gases, cooling and heating. The course studies the thermodynamic cycles of Brighton, Trinkler, Rankin and others. The discipline studies the basics of designing solar installations, i.e. solar generators and collectors, as well as heat pumps	5										



		<p>mechanics of liquids and gases. The concept of a boundary layer. Boundary layer equations. The flow of flat surfaces with a homogeneous limitless flow of liquid. The outflow of liquid through the free slots. The outflow of liquid through the cracks located near the surface. The transition of the laminar flow form to the turbulent one. Flow in round smooth pipes. Currents in rough pipes. Hydro-gas dynamics studies the laws of equilibrium and motion of liquids and gases, which are the basis of the disciplines of the special course of Thermal power Engineering. It is difficult to name any field of engineering activity in which it was not necessary to deal with the movement of liquids or gases and, therefore, not to apply to some extent the laws of mechanics of liquids and gases.</p>										
	Renewable energy	<p>The study of the physical essence of the processes of converting renewable energy sources (RES) into electrical energy and the implementation of the most economical and safe operating conditions for renewable energy plants.</p>	5									
	Industrial Energy audit and energy saving	<p>The following issues are discussed: regulatory framework for energy saving and its development trends, contractual relations of consumers with energy supplying organizations and settlement of disputable situations, tariffs and price categories for electric energy, the structure of a mandatory energy audit and an algorithm for its implementation with the development of a program for energy efficiency hanging and filling in the energy passport of the consumer of fuel and energy resources. Special attention is paid to the calculation of energy efficiency indicators, the feasibility study of organizational, technical, investment energy saving measures and the</p>	5									

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		development of a program to improve energy efficiency.											
	Thermal engineering measurements and control	The necessary knowledge on the theory and methods of measurement, methods for assessing the accuracy and reliability of measuring instruments and systems, on the state standardization system, on methods for evaluating product quality. Fundamentals of control of technological objects; thermal engineering control objects, their main features; control in start-up, stop and normal operation modes; decomposition of control objectives; automation of control; the concept of dynamic systems and types of dynamic systems; mathematical models of technological control objects;	5										
	Superchargers and heat engines	The discipline deals with various superchargers and heat engines, classification of pumps, parameters of pumps and fans.	5										
	Heat and mass exchange equipment in industrial heat power engineering	The main types and classification of heat and mass transfer equipment are considered, as well as formed the skills of their calculation and selection. Attention is paid to the operation features of various types of heat exchangers; evaporation and desalination plants; auxiliary equipment of heat-consuming plants; Physico-chemical processes in them, and ways of their intensification. Information on heat carriers, their properties and characteristics are given. The methods of calculation of heat and mass transfer equipment are studied, they are: thermal, constructive, verification, hydraulic, strength, technological and economic..	5										
	Calculation and design of heat and mass transfer equipment	Considers the processes of heat and mass transfer in the apparatus and installations of heat and power engineering. These include boiler installations, waste heat boilers, heat	5										



	Heat supply systems of enterprises	exchangers of various pressures. We consider the design and methods of calculation of recuperative and regenerative heat exchangers, deaerators, evaporation and crystallization plants, drying plants, distillation and distillation plants, absorption and adsorption apparatus. The main heat supply systems, pipeline installation, and insulation materials are considered. The issues of energy saving during transportation of coolants are touched upon.										
	Heating networks and heat supply systems of enterprises and housing and communal services  Combined-cycle gas and gas turbine installations of thermal power plants and nuclear power plants	The basics of laying thermal networks are considered - types of pipelines, locations (channel and non-channel), cathodic protection. Open and closed systems, as well as dependent and independent schemes are considered. The basics and types of steam and gas turbines used in the energy sector, the structure and thermal circuits, additional devices and equipment of thermal power plants and nuclear power plants are considered. Use and ways to increase efficiency, operating modes, variable operating modes of modern steam and gas turbines	5									
	Transients in power systems  Theoretical foundations of Fuel	The discipline "Transients in power systems" is a variable discipline that forms students' readiness to study theoretical knowledge, practical skills and skills of using algorithms for calculating electromagnetic transients that occur during short circuits and other violations of the normal operation of the energy system, as well as knowledge necessary to understand transients in electromechanical systems and their resistance to change operating modes and deviations of the operating mode from normal. Considers the combustion processes of	5									



		preparation for the study of subsequent specialized academic disciplines.											
<b>Cycle of profile disciplines</b>													
<b>Component of choice</b>													
M8	Environmental problems of thermal power engineering	Sources of environmental pollution, the problem of interaction between energy and the environment, the legislative framework of environmental policy of the Republic of Kazakhstan, sources of atmospheric pollution, fundamentals of environmental regulation, general information about the hydrosphere, sources of hydrosphere pollution, anthropogenic soil pollution, the main sources of soil pollution.	5										
	Steam turbines of thermal power plants and nuclear power plants	General information of steam turbines of thermal power plants and nuclear power plants. Working fluid flow equations. Conversion of flow energy taking into account the efficiency of machines. Characteristics of the parameters of the shovel machines. The maximum power of the turbine. Design schemes of machines. Calculation of the strength of the main parts and assemblies of steam and gas turbines.	5										
	Water treatment	As a result of successful mastering of the discipline, the student will know: the main indicators of water quality; methods of preliminary purification of water from coarse and colloidal impurities; methods of reducing alkalinity, water hardness, desalination of water; methods of preventing the formation of deposits, methods of protecting equipment from corrosion; advanced technologies for the treatment of natural waters and contaminated condensates; water and steam quality standards; condensates, mains and make-up water, feed water evaporators; features of the quality of surface waters of the region and	5										

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		methods of their treatment; be able to: analyze water with the determination of quality indicators; choose and calculate a rational scheme of water treatment plant; evaluate the main indicators of water quality; possess: skills of independent individual work; experience in using methods of water treatment; skills of using regulatory and technical literature											
	Accumulation of electrical and thermal energy	The discipline studies technologies that allow generating and storing thermal energy using new and renewable technologies	5										
	Heating and heating networks	General information and concepts of heating and heat supply, energy efficiency of heating, heat consumption, heat supply systems, energy characteristics of gas turbine heating plants, energy characteristics of combined-cycle gas heating plants, hydraulic calculation of heat networks, thermal calculation of heat networks.	5										
	Electrical and thermal measurements	The discipline "Electrical and thermal measurements" is a profile subject, where students receive basic knowledge about the theory, device, as well as their graphic designation according to state standards and the unified system of design documents (ESKD). They also gain knowledge about metrology, classification of measurements and their errors, methods of measuring various electrical and thermal quantities. The purpose of the course is to train specialists in the field of application of thermodynamics, heat exchange methods for the analysis of processes of heat and mass transfer equipment of thermal power plants and other industrial enterprises.	5										
	Heat and mass transfer equipment of the enterprise	Examines the processes of heat and mass transfer in heat power equipment and installations. These include boiler installations, waste heat boilers, heat											

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		exchangers of various pressures.											
	Combined-cycle gas and gas turbine installations of thermal power plants and nuclear power plants II  Thermal machines and GTU	The basics and types of steam and gas turbines used in the energy sector, the structure and thermal circuits, additional devices and equipment of thermal power plants and nuclear power plants are considered. Use and ways to increase efficiency, operating modes, variable operating modes of modern steam and gas turbines. The discipline deals with various superchargers and heat engines, classification of pumps, parameters of pumps and fans.	5										
	Selected Chapters of Aerohydrodynamics  Engineering ecology	The discipline presents the theoretical foundations of the construction of aerodynamic research, the main issues of aerodynamics. Contamination by radioactive elements during the operation of thermal power plants. The impact of pollution on living organisms, vegetation and the environment. Measures to limit emissions of harmful substances into the atmosphere. Reduction of sulfur dioxide emissions. Flue gas desulfurization. Methods for reducing nitrogen oxide emissions. Flue gas purification from nitrogen oxides. Maximum permissible emission concentrations. The impact of thermal power plants on the hydrosphere. problems of wastewater, water of hydrosol removal, ash and slag waste. Methods of wastewater treatment. Reduction of harmful emissions when using new combustion technologies. Calculation of the emission of pollutants during fuel combustion in boiler units of the boiler house. Calculation of emissions of harmful substances into the atmosphere during fuel combustion in boiler houses.	5										
	Heat production technology in industry	The discipline studies the main equipment involved in the production of thermal energy. Students will get	5										

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	High-potential steam production technology in thermal power plants	acquainted with the principles of operation of boiler houses, heating networks, heating points. Technological scheme of a steam boiler. Combined power plants. Technical characteristics of fuels and the efficiency of their use in the boiler. Combustion of gaseous, liquid fuel. The gorenje of a pulverized coal torch in the furnaces of steam generators. Heat exchange in boiler units. Thermal calculation and layout of steam boilers. The design of steam boilers. Energy steam boilers. Hydrodynamics of closed, open hydraulic systems. Environmental problems of fuel combustion											
	Operation of thermal power plants  Sources and systems of heat supply of enterprises and housing and communal services	The discipline studies the basics of operation of heat engineering equipment, in particular steam boilers, turbines, turbine condensers. The discipline studies the sources and systems of heat supply, i.e. thermal power plants and boiler houses. The issues of heat supply of industrial enterprises and apartment buildings are being studied.	5										
	Calculation and design of heat supply systems  Calculation and design of combined-cycle gas installations	The discipline studies the calculations of heat supply systems, heat exchange apparatuses, heat points, as well as steam and hot water boilers The discipline studies the design features of systems operating on the steam and gas cycle. The discipline studies calculation methods for gas and steam turbines, as well as waste heat boilers.	5										
	Production practice I	Consolidation of theoretical knowledge gained during the study of the basic disciplines "Technological measurements and automation system", "Technology of thermal insulation and building materials", "Applied thermophysics", "Low temperature physics"; familiarization with the technological processes of	2								+		

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		heat and electric energy generation; collection, systematization of available information, factual materials for analysis and preparation of a report; preparation for the study of subsequent core academic disciplines.											
	Production practice II	Consolidation of theoretical knowledge gained during the study of the basic disciplines "Technological measurements and automation system", "Technology of thermal insulation and building materials", "Applied thermophysics", "Low temperature physics"; familiarization with the technological processes of heat and electric energy generation; collection, systematization of available information, factual materials for analysis and preparation of a report; preparation for the study of subsequent core academic disciplines.	3										
<b>Cycle of profile disciplines</b>													
<b>University component</b>													
M9	Preparation and writing of a thesis (project)	Consolidation of theoretical knowledge, skills and abilities acquired in the process of studying at the university and in previous types of professional practice, as well as the formation of a specialist, preparation of a student for passing the state comprehensive exam in the specialty and for the implementation of a diploma project (work).	6	V									
	Defense of the thesis (project)		6										
<b>Cycle of profile disciplines</b>													
<b>Component of choice</b>													
M10	Military training	Formation of students' understanding of service in the Armed Forces of the Republic of Kazakhstan and knowledge of the basics of military affairs. To prepare students for service in the Armed Forces of the Republic of Kazakhstan on the basis of solid assimilation of theoretical knowledge of											


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		initial military training so that, being called up for military service in the Armed Forces of the Republic of Kazakhstan, graduates could adapt to the conditions of military service in a short time and master the weapons and military equipment entrusted to them.												
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### 5. Curriculum of educational program

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APPROVED  
Chairman of the Management Board Rector  
of Kazakhstani named after K.Satbayev  
M.M. Begentayev  
2024



**CURRICULUM**  
of Educational Program as enrollment for 2024-2025 academic year  
Educational program 6887122 - "Heat Power Engineering"  
Group of educational programs 0802 Electrical and Power Engineering

Form of study: full-time      Duration of study: 4 years      Academic degree: Bachelor of Engineering and Technology

Discipline code	Name of discipline	Cycle	Total amount in Academic credits	Total hours	Classes in volume of lek/leh/PR	SES (including TSD) in hours	Form of control	Allocation of face-to-face training based on courses and semesters									
								I course		II course		III course		IV course			
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester		
<b>CYCLE OF GENERAL EDUCATION DISCIPLINES (G.E.D.)</b>																	
<b>M-1. Module of language training</b>																	
LNG 108	English language	GED, RC	5	150	0/0/3	105	E	5									
LNG 108	English language	GED, RC	5	150	0/0/3	105	E		5								
LNG 104	Kazakh (Russian) language	GED, RC	5	150	0/0/3	105	E	5									
LNG 104	Kazakh (Russian) language	GED, RC	5	150	0/0/3	105	E		5								
<b>M-2. Module of physical training</b>																	
KPK 103-104	Physical Culture	GED, RC	8	240	0/0/8	120	D-credit	2	2	2	2						
<b>M-3. Module of information technology</b>																	
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	3/1/0	105	E					5					
<b>M-4. Module of socio-cultural development</b>																	
HUM 137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5								
HUM 132	Philosophy	GED, RC	5	150	1/0/2	105	E				5						
HUM 120	Socio-political knowledge module (sociology, politicalogy)	GED, RC	3	90	0/0/2	60	E				3						
HUM 124	Socio-political knowledge module (culturalogy, psychology)	GED, RC	3	150	2/0/1	105	E				5						
<b>M-5. Module of anti-corruption culture, ecology and life safety base</b>																	
HUM126	Fundamentals of anti-corruption culture and law	GED, CCH	3	150	2/0/1	150	E										
MNG489	Fundamentals of economics and entrepreneurship																
CHE356	Ecology and life safety																
MNG164	Basics of Financial Literacy																
<b>CYCLE OF BASIC DISCIPLINES (BD)</b>																	
<b>M-6. Module of physical and mathematical training</b>																	
MAT 101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5									
PHY 111	Physics I	BD, UC	5	150	1/1/1	105	E	5									
PHY 112	Physics II	BD, UC	5	150	1/0/1	105	E		5								
MAT 102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5								
MAT103	Mathematics III	BD, UC	5	150	1/0/2	105	E				5						
<b>M-7. Module of basic training of special disciplines in heat power engineering</b>																	
ERG543	Materials science in thermal power engineering	BD, UC	5	150	1/0/2	105	E	5									
ERG565	Theoretical fundamentals of heat engineering	BD, UC	4	120	2/0/1	75	E	4									
ERG153	Engineering Thermodynamics	BD, UC	5	150	2/0/1	105	E				5						
2211	Elective	BD, CCH	5	150	2/1/0	105	E				5						

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ERG566	Electrical and Electronic Engineering	BD, UC	6	180	2/0/2	120	E			6								
ERG567	Boiler Plants and Steam Generation	BD, UC	5	150	2/1/0	105	E				5							
ERG401	Energy conversion in heat power and heat engineering	BD, UC	5	150	1/1/1	105	E				5							
ERG576	Renewable energy	BD, UC	5	150	2/1/0	105	E					5						
ERG547	Industrial Energy Audit and Energy-Saving	BD, UC	5	150	2/1/0	105	E					5						
ERG544	Thermal engineering mechanisms and control	BD, UC	5	150	2/0/1	105	E					5						
ERG568	Blowers and turbo engines	BD, UC	4	120	1/1/1	75	E					4						
ERG150	Heat and Mass Exchange Equipment in Industrial Heat Power Engineering	BD, UC	5	150	1/1/1	105	E						5					
3205	Elective	BD, CCH	5	150	2/0/1	105	E										5	
3206	Elective	BD, CCH	5	150	2/0/1	105	E						5					
3207	Elective	BD, CCH	6	180	2/0/2	120	E										6	
3208	Elective	BD, CCH	5	150	2/0/1	105	E						5					
3209	Elective	BD, CCH	5	150	2/0/1	105	E										5	
AAP173	Educational practice	BD, UC	2							2								
<b>CYCLE OF PROFILE DISCIPLINES (PD)</b>																		
<b>M.4. Module of professional disciplines in heat power engineering</b>																		
ERG569	Environmental Issues in Heat Power Engineering	PD, UC	5	150	2/1/0	105	E					5						
ERG542	Steam turbines Heat power plants and nuclear power plants	PD, UC	5	150	0/3/0	105	E					5						
ERG570	Water Treatment	PD, UC	6	180	2/0/2	120	E										6	
ERG571	Accumulation of electric and thermal energy	PD, UC	4	120	2/0/1	75	E						4					
ERG563	Power and electromechanical equipment	PD, UC	4	120	2/0/1	75	E										4	
3305	Elective	PD, CCH	5	150	2/0/1	105	E						5					
3306	Elective	PD, CCH	4	120	2/0/1	75	E						4					
4302	Elective	PD, CCH	6	180	2/0/2	120	E										6	
4303	Elective	PD, CCH	5	150	2/0/1	105	E										5	
4304	Elective	PD, CCH	5	150	2/0/1	105	E										5	
4305	Elective	PD, CCH	5	150	2/0/1	105	E										5	
4306	Elective	PD, CCH	5	150	2/0/1	105	E										5	
AAP102	Production practice I	PD, UC	2								2							
AAP103	Production practice II	PD, UC	3														3	
<b>M.5. Module of Social orientation</b>																		
ECA109	Writing and defense of the thesis / project	FA	8															8
<b>M.10. Module of additional types of training</b>																		
AAP500	Military affairs	ATT	0															
<b>Total based on UNIVERSITY:</b>										31	29	28	32	29	33	27	23	
										60	60	60	60	60	60	60	60	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			Total
		required competence (RC)	university competence (UC)	Completion of hours (CCH)	
GD	Cycle of general education disciplines	51		5	56
BD	Cycle of Basic disciplines		81	31	112
PD	Cycle of profile disciplines		20	25	45
	Final for theoretical training	51	109	79	239
FA	Final assistance				9
	TOTAL:	99	190	79	368

Decision of the Academic Council of KazNU named after K.Satbayev. Protocol No 18 - 22 - 04 2024


Decision of the Educational and Methodological Council of KazNU named after K.Satbayev. Protocol No 8 - 19 - 04 2024

Decision of the Academic Council of the Institute of Energy and Mechanical Engineering. Protocol No 4 - 11 - 01 2024


Vice-Rector for Academic Affairs

  
B.K. Ukenbayeva


Director Institute of Energy and  
Mechanical Engineering

  
K.K. Yulmetov

Department Head «Power  
Engineering»

  
Ya.A. Sarsembayev

Representative of the Council from  
employers

  
A.K. Shermatov

### 6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of the development of additional educational programs (Minor)
M1 - English;			
M2 - Modern history of Kazakhstan;			
M3 - Physics 1 and 2;			
M4 - Mathematics 1,2,3;			
M5 - Theoretical foundations of electrical engineering;			
M6 – Theoretical foundations of heat engineering;			
M7 - Electric cars.			