NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY

named after K.I.SATBAYEV»

Institute of Energy and Mechanical Engineering
Department of Power Engineering

EDUCATIONAL PROGRAM

6B07128 - «Digital Power Engineering»

Code and classification of the field of education**: 6B07 Engineering, manufacturing and construction industries**
Code and classification of training areas: **6B071 Engineering and Engineering**
Group of educational programs: **B 063 Electrical Engineering and Automation**
NRK Level: **Level 6**
ORC Level: **Level 6**
Duration of study**: 4 years**
Volume of credits: **240 ECTS**

Almaty 2024

Educational program 6B07128 - «Digital Power Engineering»

was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes # 22 dated «22» 04 2024.

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council

Minutes # 06 dated «19» 04 2024.

Educational program 6B07128 - «Digital Power Engineering»

was developed by Academic committee based on direction "Engineering and Engineering"

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1. Description of educational program

The educational program is designed to train personnel for the production and engineering departments of power plants and substations, industrial production enterprises in the energy, construction, transport, metallurgical, mining, oil and gas industries and in the housing and communal services industry, as well as in secondary specialized educational institutions.

The specialty and specialization program area 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 electrical engineering and energy".

The educational program has increased the volume of mathematical, natural science, basic and language disciplines. Specialized disciplines have been added, which can be divided into three groups: disciplines in the electric power industry, disciplines in digital management and disciplines in programming. As a result, we have 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:

- Intelligent control systems of electrical networks;
- Identification of control objects in the power system;
- - Diagnostics of power system equipment;
- Digital control systems for electric drives;
- Computerized protection and safety of electrical systems;
- Energy-saving and resource-saving technologies;
- Means of optimizing electricity consumption;
- Programming logic controllers using Unity Pro;
- SCADA in the power supply system.

In the process of mastering the educational program, a Bachelor of Engineering and Technology in the field of (production, transformation, transmission and consumption) of energy (electricity) must possess the following key competencies.

The bachelor must:

have an idea:

- about modern energy facilities, about autonomous power sources and renewable energy facilities, about promising areas of energy development;
- on modern approaches to the calculation and design of energy systems, as well as to the use of software tools for the management and evaluation of energy systems;
- about modern elements and installations of electric power systems (devices, apparatuses, equipment, etc.);
- about modern applications used in energy systems;

To know:

- theoretical and experimental research methods in order to create new promising areas in the field of energy;
- principles of operation, technical characteristics and design features of the energy facilities being developed and used;
- standards, methodological and regulatory materials, fundamentals of design, installation and operation of electrical installations in the energy industry;
- modern and promising directions for the development of energy and electrical systems, principles of operation, technical characteristics and design features of energy and electrical installations and systems being developed and used;
- fundamentals of programming for the creation of control systems for electrical systems;

be able to:

- to develop the principles of organization and design of the electrical part of enterprises;
- use application programs for calculations, modeling and automation of energy systems design;
- use theoretical information on the organization of the technological process of electricity generation;
- develop programs for managing technological processes of energy systems;
- to solve the main issues of power supply systems; issues related to the design features of internal power supply systems, electrical networks, substation equipment;
- use energy supply calculation methods.
- apply methods and measuring instruments used in the production, transmission and consumption of electric energy;
- to use energy- and resource-saving technologies, to carry out a preliminary feasibility study of design calculations;
- to carry out calculations on electricity consumption of electric power plants.

have skills:

- formulate the main technical and economic requirements for the designed power systems;
- organization of work on the operation, installation and commissioning of electrical and energy 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 resources.
- Calculate energy losses in various electrical equipment.

During the training, production practices are provided at such enterprises as: NC "KEGOC", JSC "AZHK", JSC "AlES", LLP "Elcos", JSC "Kazatomprom", LLP "Kazzinc", "Karachaganak Petroleum Operating", "Kazminerals". Kazakhmys and others.

2. Purpose and objectives of educational program

The purpose of EP: The purpose of the educational program is to teach students general education, basic and profile disciplines with the achievement of relevant competencies. Training of bachelors with professional knowledge in the design, installation, operation and repair of power plant equipment, power supply sources for industrial enterprises, cities and agriculture, with an understanding of the classical and new areas of modern energy and environmental technologies, and able to apply the knowledge gained in scientific, practical and production activity.

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

3. Requirements for the evaluation of learning outcomes of the educational program

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 communi-cate fluently with a second language - The ability to use communi-cative communication in different situations - There are basics to acade-mic writing in their native language	Full 4-year study with a minimum of 240 academic loans (of which 120 contact classroom academic credits) 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	Department of Kazakh and Russian, Department of English

		- Diagnostic language test		
G2	Mathematical Literacy	- Basic mathematical thinking at the communication level - the ability to solve situational problems on the basis of the mathematical apparatus of algebra and began mathematical analysis - Diagnostic test for mathe-matical literacy in algebra	Full 4-year study with a minimum of 240 academic loans (of which 120 are contact auditary 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	Mathematics Department
G3	Basic literacy in science disciplines	- A basic understanding of the scientific picture of the world with an understanding of the basic laws of science - Understanding basic hypotheses, laws, methods, drawing conclusions and assessing errors	Full 4-year study with a minimum of 240 academic loans (of which 120 are contact auditary 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	Departments in the fields of natural sciences
Specific (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)				
S1	Communication	- Fugitive bilingual oral, written and communication skills - The ability not to communi-cate fluently with a third language - writing skills of different styles and genres - skills of deep understanding and interpretation of one's own work of a certain level of complexity (essay) - basic aesthetic and theore-tical literacy as a condition of full perception, interpretation of the original text	Full re-repayment of credits by language (Kazakh and Russian)	Department of Kazakh and Russian
S2	Mathematical Literacy	- Special mathematical thin-king using induction and deduction,	Re-credit for The Discipline of Mathematics (Calculus) I	Mathematics Department

		generalization and specification, analysis and synthesis, classification and systematization, abstraction and analogy - The ability to formulate, substantiate and prove positions - Application of common mathematical concepts, formulas and extended spatial perception for mathematical tasks - Full understanding of the basics of mathematical analysis		
S3	Special literacy in science disciplines (Physics, Chemistry, Biology and Geography)	- A broad scientific percep-tion of the world that suggests an understanding of natural phenomena - Critical perception to understand the phenomena of the world around - cognitive ability to formulate a scientific understanding of the forms of existence of matter, its interaction in nature	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	- Readiness for further self-learning in English in various fields - Ready to gain experience in design and research using English	Refilort English credits above academic to professional level (up to 15 credits)	Department of English
S5	Computer skills	- Basic programming skills in one modern language - Use software and applications to teach different disciplines	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	- Understanding and understanding the responsibility of every citizen for the development of the country and the world	Re-credit for Kazakhstan's Modern History (excluding state exam)	Department of Public Discipline

		- The ability to discuss ethical and moral aspects in society, culture and science		
		- Critical understanding and the ability to debate on modern scientific hypotheses and theories	Re-credit credits for philosophy and other humanities	
PROFESSIONAL (includes reduced education by re-counting credits depending on the level of knowledge on competences for college graduates, AV schools, universities)				
P1	Professional competencies	- Critical perception and a deep understanding of professional competencies at level 5 or 6 - The ability to discuss and debate professional issues within the framework of the mastered program	Re-credits for basic professional disciplines, including introduction to specialty, engineering ethics, robotic technology, automation technology, theoretical basics of electrical engineering, technological measurements and instruments, mathematical basics of control theory, electronic automation devices.	Releasing chair
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 transfer loans if the low diagnostic level is confirmed or the final grades in completed disciplines were below A and B.

4. Passport of educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	6B07 Engineering, manufacturing and construction industries
2	Code and classification of training areas	6B071 Engineering and Engineering
3	Group of educational programs	B063 Electrical engineering and automation
4	Name of the educational program	Digital Power Engineering
5	Brief description of the educational program	The educational program is designed to train personnel for the production and engineering departments of power plants and substations, industrial production enterprises in the energy, construction, transport, metallurgical, mining, oil and gas industries and in the housing and communal services industry, as well as in secondary specialized educational institutions. The specialty and specialization program area 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 energy". The educational program has increased the volume of mathematical, natural science, basic and language disciplines. Specialized disciplines have been added, which can be divided into three groups: disciplines in the electric power industry, disciplines in digital management and disciplines in programming. As a result, we have an educational program that has innovative and practical content and is aimed at implementing the Digital Kazakhstan program.
6	Purpose of the EP	The purpose of the educational program is to teach students general education, basic and profile disciplines with the achievement of relevant competencies. Training of bachelors with professional knowledge in the design, installation, operation and repair of power plant equipment, power supply sources for industrial enterprises, cities and agriculture, with an understanding of the classical and new areas of modern energy and environmental technologies, and able to apply the knowledge gained in scientific, practical and production activity.
7	Type of EP	Innovative
8	The level of the NRK	6 level
9	ORC Level	6 level
10	Distinctive features of the EP	No
11	List of competencies of the	A - knowledge and understanding:

	educational program:	A1 - methods for constructing electrical, technological and functional diagrams for the design of electric power systems; A2 - modern trends in the development of technical and technological systems of energy facilities; A3 - standards, methodological and regulatory materials accompanying the operation, installation and commissioning of electric power facilities; A4 - the basics of programming, to create control systems for electrical systems. B - application of knowledge and understanding: B1 - independent work and the proposal of various options for solving professional problems using theoretical and practical knowledge; B2 - for organizing work on the installation, commissioning and operation of electric power systems; B3 - for the organization of work on the collection, storage and processing of information used in the field of professional activity. C - the formation of judgments: C1 - about modern facilities of the energy industry and process control systems; C2 - on the use of modern systems of autonomous energy supply for various categories of consumers; C3 - on modern technical devices and technological equipment of energy facilities (devices, apparatus, equipment, actuators, etc.); C4 - about modern application programs used in energy systems; D - personal abilities: D1 - to be an energy engineer, an electrical engineer of the production unit for the operation of energy systems; D2 - to be a specialist in maintenance of electrical networks and systems; D3 - to be an engineer of the production unit for the repair of electrical and electrical installations; D4 - to be able to organize work on the adjustment of energy and electromechanical installations of industrial enterprises. ***Competencies upon completion of training*** B - Basic knowledge, skills and abilities: B1 - capable of philosophical analysis of social phenomena, behavior of the individual and other phenomena. Ready to conduct a philosophical assessment of social phenomena; B2 - know and apply in practice the basics of engineering professional ethics; B3 - be able to analyze the actual problems of the modern history of Kazakhstan. P - Professional competencies, including in accordance with the requirements of industry professional standards:

		P1 - a wide range of theoretical and practical knowledge in the professional field; P2 - able to analyze and solve problems on the basics of electrical engineering and automatic control; P3 - is able to analyze electrical, electrical and wiring diagrams of technological production. Ready to install, adjust and operate electrical installations and systems. M - Universal, social and ethical competencies: O1 - is able to use English fluently as a means of business communication, a source of new knowledge in the field of electrical engineering and energy. Ready to use English in professional activities in the field of energy; O2 - is able to speak Kazakh (Russian) fluently as a means of business communication, a source of new knowledge in the field of electrical engineering and energy. Ready to use the Kazakh (Russian) language in professional activities in the field of energy; O3 - to know and apply in work and life the basics of applied ethics and ethics of business communication; O4 - know and apply the basic concepts of professional ethics; O5 - know and apply in practice the "engineer's code of ethics"; O6 - to know and solve the problems of human impact on the environment. C - Special and managerial competencies: C1 - independent management and control of the processes of labor and educational activities within the framework of the strategy, policy and goals of the organization, discussion of the problem, argumentation of conclusions and competent handling of information; C2 - in the field of organizational and managerial activities: to be the head of the group of the unit for the operation, installation and repair of power plants in various industries; C3 - in the field of experimental research activities: to be a specialist in conducting experimental research of electric power facilities; C4 - in the field of research activities: to be an engineer in a scientific laboratory for research and development of modern power plants and systems in various industries; C5 - in the field of design and development: to be an engineer for the development and design of electric power plants and systems in various industries.
12	Learning outcomes of the educational program:	Obligatory standard requirements for graduation from a university and awarding an academic degree of a bachelor: mastering at least 240 academic credits of theoretical training and a final thesis or a state exam in a specialty. Special requirements for graduation from this program *the graduate should know:* - theoretical and experimental methods of research in order to create new promising areas in the field of energy; - principles of operation, technical characteristics and design features of the energy devices being developed and used;

		- standards, methodological and regulatory materials, basic design, installation and operation of electrical installations in the energy industry; *the graduate should be able to:* - to carry out and design power supply plans for energy enterprises; - use application software packages for calculations, modeling and automation of the design of energy systems; - to formulate the main technical and economic requirements for the designed energy systems; - organize work on the operation, installation and adjustment of electrical devices and equipment. The training in this EP ends with the passing of the state exam in the following disciplines or the defense of the diploma project (work) before the SAC.
13	Form of training	Daytime
14	Duration of training	4 years
15	Volume of loans	240 ECTS
16	Languages of instruction	Kazakh, Russian
17	Academic degree awarded	Bachelor of Engineering and Technology in EP "6B07128- Digital Power Engineering"
18	Developer(s) and authors:	Sarsenbayev E.A., Berdibekov A.O., Abitayeva R.Sh.

	КК1
РО1	Shows knowledge about society as an integral system and a person. He knows about the role of spiritual processes in modern society, about the legal interests of the parties in the field of protecting the rights of individuals and legal entities. Has an understanding of the economic and social conditions of entrepreneurial activity, the impact of harmful and dangerous factors on humans and the natural environment.
РО2	Possesses basic knowledge in the field of natural sciences, contributing to the solution of professional problems in the field of energy and the formation of a highly educated personality with a broad outlook.
РО3	Able to use tables and charts. Has knowledge of modern methods and devices for control and metering of electricity. Knows modern and future directions of development of power systems, principles of operation, technical characteristics and design features of developed and used power plants.
РО4	Expands and systematizes the acquired knowledge in the course of studying the disciplines of the module. Gains experience in reading and constructing various types of diagrams.
РО5	Applies methods for calculating electrical systems. Conducts electrical calculations of industrial electrical equipment. Analyzes the modes of operation of electrical systems, applies methods for their study.
РО6	Introduces innovative approaches to practical activities to achieve concrete results in the field of energy. Independently processes and makes the right decision when creating or mastering new technologies and materials.
РО7	Uses knowledge of basic disciplines to understand the physical essence of the processes occurring in the objects of the main and auxiliary equipment of objects of electric power systems.
РО8	Demonstrates the ability to design systems, system components or processes to achieve a desired result, taking into account realistic constraints (profitability,

	environmental and social impact, ethics, health and safety, manufacturability and sustainability).
PO9	Owns the methods of design, calculation and regulation of energy production and distribution systems, applies information technology to solve engineering problems by computer processing methods. Knows how to use computer technology to process measurement results, comply with the requirements of GOSTs and industry standards.
PO10	Knows and understands modern social, political problems and problems in the field of electric power industry.
PO11	Understands the benefits and potential challenges of teamwork, describing the qualities and processes required for effective teamwork, and the role of teamwork in the engineering design process.
PO12	Understands the importance of career planning and management.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Name of the discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)											
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Cycle of general education disciplines Required component															
M1	English 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.	10	+											
	Kazakh (Russian) language	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												
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, network and web applications. Be able to write programs for various calculations in software shells.	5												
4	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												
	Politology	The training course "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 functioning of politics, prepare students to participate in the political life of the country, and form an active civic position.	5												
	Culturology	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.	5												
	Psychology	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.	5												
M5	The basics of anti-corruption culture	The discipline studies the essence, causes, causes of sustainable development of corruption from both historical and modern points of view. Considers the prerequisites and impacts for the development of an anti-corruption culture. Studies the development of countering corruption on the basis of social, economic, legal, cultural, moral and ethical norms. She studies the problems of forming an anti-corruption culture based on the relationship with various types of social relations and various manifestations.	5	+											
	Fundamentals of entrepreneurship and leadership	The discipline studies the foundations of entrepreneurial activity and leadership from the point of view of science and law; features, problematic aspects and development prospects; theory and practice of entrepreneurship as a system of economic, organizational and legal relations of business structures; readiness of entrepreneurs for innovative susceptibility. The discipline reveals the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of an entrepreneur, theoretical and practical business planning and economic expertise of business ideas, as well as risk analysis of innovative development, introduction of new technologies and technological solutions.	5	+											
	Ecology and life safety	The discipline studies the tasks of ecology as a science, environmental terms, the laws of the functioning of natural systems and aspects of environmental safety in the conditions of labor activity. Monitoring of the environment and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems; life safety in the technosphere; natural and man-made emergencies.	5												

Cycle of basic disciplines University component															
M6	Mathematics	Elements of linear algebra and analytic geometry. Introduction to mathematical analysis. Differential calculus of a function of one variable and its applications. Integral calculus of a function of one variable and its applications. Differential calculus of a function of many variables. Multiple integrals. Applications. Series theory. Differential equations. Elements of probability theory and mathematical statistics.	5		+										
	Physics	Mechanics. Kinematics. Dynamics of a material point and a solid body. Conservation laws. Elements of the special theory of relativity. Elements 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.	5		+										
Cycle of basic disciplines University component															
M7	Reading electrical circuits	General information about drawings and diagrams of electrical installations; Conditional graphic symbols in electrical circuits; Regulatory documents and standards for the development of electrical circuits; General rules for the implementation of schemes; Electrical structural, functional and circuit diagrams.	5						+						
	Introduction to specialty	Energy resources and their use. Renewable and non-renewable energy sources. Fundamentals of technical thermodynamics. Fundamentals of the theory of heat transfer. Convective and radiant heat transfer. Modern methods of obtaining electrical energy. Cycles of thermal, electrical, hydroelectric and nuclear power plants. Methods for converting various types of energy into electrical energy. Non-traditional ways of obtaining energy. The concept of the electrical system. Management of electric power systems. Influence of technology and energy on the biosphere.	4					+							
	Engineering and computer graphics	The study of the theoretical foundations for the implementation and reading of design documents, methods for constructing spatial forms on a plane, methods for solving engineering and technical problems on a drawing, developing students' spatial thinking and instilling independent work skills.	4			+									
	Theoretical Foundations of Electrical Engineering I	DC electrical circuits; linear electrical circuits of alternating current; three-phase circuits; transient processes in linear electrical circuits.	6			+									
	Modern industrial electronics	Characteristics of semiconductor components of electronics; schemes of uncontrolled and controlled rectifiers; arrangement of optoelectronic devices; electrical signal amplifiers; converter power supplies; frequency converters; digital converters; microprocessors.	6												
	Theoretical Foundations of	Nonlinear circuits; transient processes in non-linear circuits; electrical circuits with distributed parameters; magnetic circuits.	6												

	Electrical Engineering II														
	Solving Electrical Engineering Problems in MATLAB	Compilation of characteristic equations and the use of various integration and differentiation methods for solving electrical engineering problems in the MATLAB program	6							+					
	Theoretical mechanics	Studying the basics of general mechanics, the principles of functioning of typical mechanisms, machines and devices, as well as the fundamentals of the mechanics of materials and structures, their calculation and design.	4												
	Measurement of electrical and non-electrical quantities	Basic knowledge of metrology and electrical measurements. Basic methods and means of measuring electrical and non-electric quantities. Information about the devices, the principles of action and the special features of the application of measuring instruments. Classifications of measurements and their errors.	5												
	Basics of programming	Familiarization of students with programming technologies - with a structural approach to programming, with object-oriented programming, methods of designing user interfaces. Issues of developing programs in high-level programming languages. Studying typical algorithms for sorting arrays, searching in arrays, strings and files, working with dynamic data structures, solving combinatorial optimization problems. Gaining skills in creating programs based on the technical passport of the object.	5												
	Theory of automatic control	Basic principles and methods of the theory of automatic control: construction of control systems, methods of their mathematical description, criteria for assessing the stability and quality of regulation of linear continuous deterministic systems, as well as the foundations of the theory of automatic control of nonlinear systems.	5											+	
	Electrotechnical materials science	Classification of electrical materials; dielectrics, their electrical conductivity, breakdown of gases, liquid and solid dielectrics; thermal conductivity; radiation resistance of materials; liquid dielectrics; polymers; inorganic electrical insulating materials; conductive, superconducting and semiconductor materials. Magnetic materials, classification and properties of magnetic materials.	5						+						
	Electrical insulation and cable equipment	Electrical breakdowns in gases, liquids, solid and combined materials; generation of direct, alternating and pulsed high voltage; VN measurement; non-destructive testing of insulation; surge and surge protection; isolation coordination.	5												
	Fundamentals of power supply of industrial enterprises	The study of calculation methods, design analysis of workshop power supply systems, development of skills for independent solution of engineering problems and practical application of theoretical knowledge, study of the principles of designing power supply systems at the stages of electrical loads of industrial enterprises with voltage up to 1 kV.	5										+		

	Transmission of electrical energy	Characteristics of energy and electrical systems. Designs of overhead and cable power lines. Equivalent circuits of the network and transformers. Loss of power, voltage, electricity. Technical and economic indicators. The quality of electrical energy. Network connection diagram or network configuration.	5											+	
	Means of automation of control processes in the electric power industry	Modern devices, equipment, methods and software for automating the process of production, conversion, transmission and consumption of electricity.	5												
	Intellectual control systems for electrical networks	Processing of steady state data for various operational purposes; diagnostics of protection and automation with alarm; remote change of digital RPA settings, management of their commissioning; registration and signaling of the occurrence of ferroresonance modes in the network; validation of input information; equipment diagnostics and control; formation of a database, storage and documentation of information; technical metering of electricity and control of energy consumption; control of power quality parameters; automatic emergency control;	5						+						
	Transition in power supply systems	Electromagnetic and electromechanical transients; calculation of symmetrical and asymmetric short circuits in power systems; limitation of short circuit currents; static and dynamic stability of the power system and ways to improve them.	6			+			+						
	Stability of the power systems	Theoretical knowledge, practical skills and abilities to use algorithms for calculating electromagnetic transients that occur during short circuits and other violations of the normal operation of the power system, as well as the knowledge necessary to understand transients in electromechanical systems and their resistance to changes in operating modes and deviations of the operating mode from normal.	6										+		
	Identification of control objects in the power system	The main types of sensors for electrical and non-electric quantities and their application in monitoring and control systems are considered. Drawing up functional diagrams of the control object and derivation of the transfer function of sensors.	4						+						
	Modeling of power converters of energy	Modeling of single-phase and three-phase power converters, modeling of DC machines, modeling of asynchronous and synchronous machines, modeling of switching devices.	4												
	Programming Logic Controllers with Unity Pro	Hardware part configuring programmable logic controllers. Unity Pro application development environment. Programming and operation of controllers.	5												

	SCADA in the power supply system	Structure and composition of SCADA. SCADA functions. End-to-end SCADA design. Basic hardware and software VijeoCitect to create a SCADA system in the power supply system.	5												
	Educational practice	Consolidation of theoretical knowledge gained in the study of the basic disciplines "Theoretical foundations of electrical engineering", "Introduction to the specialty", "Reading electrical circuits"; familiarization with the technological processes of generating electrical energy; acquisition of practical skills and abilities; collection, systematization of available information, factual materials for analysis and reporting; preparation for the study of subsequent specialized academic disciplines.	2												
Cycle of profile disciplines Component of choice															
M8	Laboratory workshop on modern industrial technologies in the electric power industry I	Entering variables and selecting their type. Creation of animation tables and operator screens. The use of variables to create a control program for a simple object. The program of management of a working course and a stop in the automatic mode. Principle of operation and application of inductive, capacitive and end sensors.	5								+				
	Electrical machines	The study of the theoretical foundations of the operation of a transformer, DC and AC machines, their main parameters and characteristics for the purpose of their subsequent practical application and preparation for understanding the course on electric drive.	5										+		
	Control system software	The main programs used in the design and operation of energy systems, power plants, electrical substations, etc. Complex calculation and analysis of electrical power systems. Standards and trends in modeling and analysis of power systems. Predictive modeling of electric power systems.	6					+							
	Laboratory workshop on modern industrial technologies in the electric power industry II	Study of methods for switching on an asynchronous motor. Electromagnetic compatibility. Electric drive based on FC ATV31 and ATV71. Exploring the Habilis system. Reactive power compensation.	4												
	Energy and electrical equipment	Acquaintance with the basics of the theory and practice of machine learning. Important questions in the practical application of machine learning and some projects related to its application. Acquaintance with machine learning, its application to solve specific problems that arise in the process of scientific research and in practical applications.	4												
	Automated electric drive	Typical diagrams of AED controlled by asynchronous motors; Principles of construction of multi-loop systems of automated electric drive; Complete electric drives with valve motor and frequency control; Electric drive of various general industrial installations.	5						+						

	Digital control systems for electric drives	Electric drives controlled by asynchronous motors with frequency converters; Principles of construction of multi-loop systems of automated electric drive; Complete electric drives with frequency control; Setting up frequency converters for electric drives of various general industrial installations.	5			+									
	Electrical equipment of substations and power plants	Classification of electrical devices and requirements for them. Electrodynamic forces in electrical devices. Heating of electrical apparatus. Electrical contacts. Electromagnets. Fundamentals of the theory of combustion and extinguishing of an electric arc. Insulation of electrical apparatus. High voltage automatic switches. Disconnectors, separators and short circuiters. Reactors, arresters. Measuring current and voltage transformers.	4												
	Digital electrical apparatus	Contactors and magnetic starters, thyristor starters. Controllers, command devices and rheostats. Automatic switches and fuses. Electromagnetic current and voltage relays. Thermal relay, time relay, polarized, indicator relays. magnetic amplifiers. Semiconductor electrical devices.	4			+		+							
	Microprocessor digital protection	Abnormal operating modes in electrical systems. Requirements for the protection of power systems. Basic principles for the implementation of protection and automation circuits. Bodies of protection of power systems. Sources of operating current for power supply of power systems protection devices. Power line protection. Current protection. Ground fault protection in electrical networks. Remote protections. Differential current protection. Protection of transformers and autotransformers from internal and external damage. Protection of synchronous generators of electric motors.	6					+							
	Computerized protection and safety of electrical systems	Requirements for the protection of power systems. Basic principles for the implementation of protection circuits and automation of ES. Current and voltage sensors for power system protection devices. Current protection. Ground fault protection in electrical networks. Remote protections. Differential current protection. Protection of electrical equipment.	6			+									
	Lighting technology and lighting	Sources of light. Classification of light sources. Basic parameters of light sources. Lighting. Light fixture settings. Classification of lighting fixtures. Design of lighting installations. Basic methods for calculating lighting.	5						+						
	Energy-saving and resource-saving technologies in power engineering	Energy-saving and resource-saving devices, equipment and methods in the production, conversion, transmission and consumption of electrical energy.	5								+				
	Quality of electrical energy	Issues of ensuring the quality of electrical energy. The main causes and sources of interference that degrade the quality of EE. Methods and	5								+				

		measures to improve the quality of EE. Electromagnetic compatibility in power supply systems.													
	Power consumption optimization tools	Methods for optimizing electricity consumption. Devices, equipment and optimization methods in the production, conversion, transmission and consumption of electrical energy.	5												
	Operation and diagnostics of electrical equipment	Diagnostics, organization of technical operation, maintenance and repair of electrical equipment. Ways to organize the maintenance of electrical machines, transformers, power lines and cables. Modern methods of diagnostics of electrical equipment.	5											+	
	Basics of electrical safety	The state and causes of electrical injuries at general industrial and specific enterprises, information about legislation in the field of safety; protective measures and means of electrical safety in general-purpose electrical installations; the basics of organizing the safe operation of electrical installations.	5										+		
	Installation and adjustment of electrical equipment	Formation of knowledge in the field of operation of power supply equipment; mastering the skills and abilities of evaluating the functional, quantitative and qualitative characteristics of devices. The main equipment of power plants - generators, transformers, electric motors and their operation.	5												
	Calculation, projecting and modeling of power supply systems	Mastering practical methods for calculating the loads of any power supply system, methods for choosing power and protective equipment, methods for calculating lighting, grounding and lightning protection.	5								+		+		
	Calculation, projecting and modeling of electrical power networks and systems	Characteristics of energy and electrical systems. Designs of overhead and cable power lines. Equivalent circuits of the network and transformers. Calculation of parameters of steady-state modes of electrical networks. Loss of power, voltage, electricity. Technical and economic indicators. The quality of electrical energy. Network connection diagram or network configuration.	5			+									
	Calculation, design and modeling of electrical system automation	Mastering practical methods for calculating power converters for the power supply system and their modeling, methods for choosing power and protective equipment. Design of automation and relay protection of various electric power plants.	5												
	Calculation, design and modeling of automated electric drive	Typical diagrams of AED controlled by asynchronous motors; Principles of construction of multi-loop systems of automated electric drive; Complete electric drives with valve motor and frequency control; Electric drive of various general industrial installations.	5			+						+			
	Production practice I	Consolidation of theoretical knowledge gained in the study of basic disciplines "Measurement of electrical and non-electric quantities", "Theoretical foundations	2												

		of electrical engineering", "Modern industrial electronics"; familiarization with the technological processes of generating electrical energy; collection, systematization of available information, factual materials for analysis and reporting; preparation for the study of subsequent major academic disciplines.													
	Production practice II	Consolidation of theoretical knowledge gained in the study of the basic disciplines "Electrical machines", "Fundamentals of power supply of industrial enterprises", "Transmission of electrical energy", "Automated electric drive"; familiarization with the technological processes of generating electrical energy; collection, systematization of available information, factual materials for analysis and reporting; preparation for the study of subsequent major academic disciplines.	3												
Cycle of major disciplines Component of choice															
M9	Preparation and writing of a thesis (project)	Consolidation of theoretical knowledge, skills and abilities obtained in the process of studying at the university and in previous types of professional practice, as well as the formation of a specialist, preparing a student for passing the state comprehensive exam in the specialty and for completing a graduation project (work).	4												
	Defense of the thesis (project)		4												
Cycle of major disciplines Component of choice															
M10	Military affairs	Formation of students' ideas about service in the Armed Forces of the Republic of Kazakhstan and knowledge on the basics of military affairs. To prepare students for service in the Armed Forces of the Republic of Kazakhstan on the basis of a solid assimilation of the theoretical knowledge of initial military training so that, being called up for military service in the Armed Forces of the Republic of Kazakhstan, graduates can quickly adapt to the conditions of military service and master the entrusted them with weapons and military equipment.													

NJSC "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATPAEV"

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board
Rector of KazNRTU named after K.Satpayev
M.M. Begentayev
"__" _____ 2024

CURRICULUM
of Educational Program on enrollment for 2024-2025 academic year

Educational program 6B07128 - "Digital Power Engineering"
Group of educational programs B063 - "Electrical Engineering and Automation"

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

Discipline code	Name of disciplines	Cycle	Total amount in Academic credits	Total hours	classroom volume of lek/lab/p	SIS (including TSIS) 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
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
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						
M-2. Module of physical training															
KFK 101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Diferedit	2	2	2	2				
M-3. Module of information technology															
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	90	E				5				
M-4. Module of socio-cultural development															
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, politology)	GED, RC	3	90	1/0/1	60	E				3				
HUM 134	Socio-political knowledge module (culturology, psychology)	GED, RC	5	120	0/0/2	90	E			5					
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM 136	Fundamentals of Anti-Corruption Culture and Law	GED, CCH	5	150	2/0/1	105	E				5				
MNG 489	Fundamentals of Economics and Entrepreneurship														
MSM500	Scientific research methods														
CHE 656	Ecology and life safety														
MNG564	Basics of Financial Literacy														
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
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	90	E	5							
PHY 112	Physics II	BD, UC	5	150	1/1/1	90	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					
M-7. Module of basic training of special disciplines in Digital power engineering															
ERG158	Reading electrical circuits	BD, UC	5	150	1/0/2	105	E	5							
ERG556	Introduction to the specialty	BD, UC	4	120	2/0/1	75	E	4							
GEN101	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E			5					
ELC542	Theoretical Foundations of Electrical Engineering I	BD, UC	5	150	2/1/0	120	E			5					
ERG606	Modern industrial electronics	BD, UC	6	180	2/1/1	120	E			6					
2211	Elective	BD, CCH	5	150	2/1/0	105	E				5				
GEN412	The theoretical mechanics	BD, UC	5	150	2/0/1	105	E				5				
ERG607	Measurement of electrical and non-electrical quantities	BD, UC	5	150	2/1/0	105	E					5			
CSE155	Algorithmization and Programming	BD, UC	5	150	1/1/1	105	E					5			

ROB512	Theory of automatic control	BD, UC	5	150	2/1/0	105	E					5			
3205	Elective	BD, CCH	5	150	2/0/1	105	E					5			
ERG608	Fundamentals of power supply of industrial enterprises	BD, UC	5	150	2/0/1	105	E						5		
ERG609	Transmission of electrical energy	BD, UC	5	150	1/1/1	105	E							5	
3206	Elective	BD, CCH	5	150	2/0/1	105	E						5		
3207	Elective	BD, CCH	6	180	2/1/1	120	E							6	
3208	Elective	BD, CCH	4	120	2/0/1	75	E						4		
3209	Elective	BD, CCH	5	150	2/0/1	105	E							5	
AAP173	Educational practice	BD, UC	2						2						
CYCLE OF PROFILE DISCIPLINES (PD)															
M-8. Module of professional disciplines in Digital power engineering															
ERG504	Laboratory workshop on modern industrial technologies in the electric power industry I	PD, UC	5	150	0/3/0	105	E					5			
ERG527	Electrical machines	PD, UC	5	150	2/1/0	105	E					5			
ERG610	Control system software	PD, UC	6	180	2/1/1	120	E							6	
ERG562	Laboratory workshop on modern industrial technologies in the electric power industry II	PD, UC	4	120	0/3/0	75	E						4		
ERG563	Power and electrotechnical equimpment	PD, UC	4	120	2/0/1	75	E							4	
3305	Elective	PD, CCH	5	150	1/1/1	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	1/0/2	105	E							5	
AAP102	Production practice I	PD, UC	2								2				
AAP183	Production practice II	PD, UC	3										3		
M-9. Module of final attestation															
ECA109	Writing and defense of the thesis / project	FA	8												8
M-10. Module of additional types of training															
AAP500	Military affairs	ATT	0												
	Total based on UNIVERSITY:							31	29	28	32	30	30	37	23
								60		60		60		60	

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		required component (RC)	university component (UC)	component of choice (CCH)	Total
GED	Cycle of general education disciplines	51		5	56
BD	Cycle of basic disciplines		82	30	112
PD	Cycle of profile disciplines		29	35	64
	Total for theoretical training:	*51*	*111*	*70*	*232*
FA	Final attestation	8			8
	TOTAL:	59	111	70	240

Decision of the Academic Council of Kaznu named after K.Satpayev. Protocol № 12 "22" 04 2024y.

Decision of the Educational and Methodological Council of Kaznu named after K.Satpayev. Protocol № 6 "18" 04 2024y.

Decision of the Academic Council of the Institute of Energy and Mechanical Engineering. Protocol № 4 "18" 01 2024y.

Vice-Rector for Academic Affairs — **B.K. Uskenbayeva**

Director Institute of Energy and Mechanical Engineering — **K.K. Yelemessov**

Department Head «Power Engineering» — **Ye.A. Sarsenbayev**

Specialty Council representative from employers — **Ye.A. Zholdybekov**

NJSC "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATPAYEV"

SATBAYEV UNIVERSITY

ASSERT
Director Institute of Energy and Mechanical Engineering
K.K. Yelemessov
"22" 04 2024 .

ELECTIVE DISCIPLINES of the educational program on enrollment for the 2024-2025 academic year
Educational program 6B07128 - "Digtal Power Engineering"
Group of educational programs B063 - "Electrical Engineering and Automation"

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

Year of study	Elective code according to the curriculum	Discipline code	Name of disciplines	semester	Cycle	Credits	Total hours	lek/lab/pr	SIS (including TSIS) in hours
1	**Module of basic training of special disciplines in Digital power engineering**								
	2211	ELC543	Theoretical Foundations of Electrical Engineering II	4	BD, CCH	5	150	2/1/0	105
		ERG611	Solving Electrical Engineering Problems in MATLAB					2/1/0	
	3205	ERG176	Electrotechnical materials science	5	BD, CCH	5	150	2/0/1	105
		ERG441	Electrical insulation and cable equipment						
		MNG563	Fundamentals of sustainable development and ESG projects in Kazakhstan						
	3206	ERG612	Means of automation of control processes in the electric power industry	6	BD, CCH	5	150	2/1/0	105
		ERG613	Intellectual control systems for electrical networks						
		MNG562	Legal regulation of intellectual property					2/0/1	
	3207	ERG614	Transition in power supply systems	7	BD, CCH	6	180	2/1/1	120
		ERG615	Stability of the power systems					2/1/1	
	3208	ERG616	Identification of control objects in the power system	6	BD, CCH	4	120	2/0/1	75
		ERG617	Modeling of power converters of energy					2/0/1	
	3209	ERG618	Programming Logic Controllers with Unity Pro	7	BD, CCH	5	150	2/1/0	105
		ERG619	SCADA in the power supply system						
		CSE831	Fundamentals of Artificial Intelligence					1/0/2	
2	**Module of professional disciplines in Digital power engineering**								
	3305	ERG538	Automated electric drive	6	PD, CCH	5	150	1/1/1	105
		ERG635	Digital control systems for electric drives					1/1/1	
	3306	ERG620	Electrical equipment of substations and power plants	6	PD, CCH	4	120	2/0/1	75
		ERG621	Digital electrical apparatus					1/1/1	
	4302	ERG622	Microprocessor digital protection	7	PD, CCH	6	180	2/0/2	120
		ERG623	Computerized protection and safety of electrical systems					2/0/2	
	4303	ERG508	Lighting technology and lighting	8	PD, CCH	5	150	2/0/1	105
		ERG624	Energy-saving and resource-saving technologies in power engineering					2/0/1	
	4304	ERG625	Quality of electrical energy	8	PD, CCH	5	150	2/0/1	105
		ERG626	Power consumption optimization tools					2/0/1	
	4305	ERG627	Electric equipment operation	8	PD, CCH	5	150	2/0/1	105
		ERG124	Electrical safety					1/1/1	
		ERG628	Power system equipment diagnostics					2/0/1	
	The "R&D" module								
	4306	ERG632	Calculation, projecting and modeling of power supply systems	7	PD, CCH	5	150	1/0/2	105
		ERG629	Calculation, projecting and modeling of electrical power networks and systems						
		ERG630	Calculation, design and modeling of electrical system automation						
		ERG631	Calculation, design and modeling of automated electric drive						

Number of credits for the entire period of study	
Cycles of disciplines	**Credits**
Cycle of basic disciplines (B)	**30**
Cycle of profile disciplines (P)	**35**
Total:	**65**

Decision of the Scientific Council of the Institute Protocol № 4 "18" 01 2024

Department Head «Power Engineering» **Ye.A. Sarsenbayev**

Specialty Council representative from employers **Ye.A. Zholdybekov**