MODULAR EDUCATIONAL PROGRAM
6B07125 "ELECTRIC POWER INDUSTRY"

Semey, 2021

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Represented by employers.
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CONTENT

EXPLANATORY NOTE

The modular educational program (MEP) is compiled on the basis of the State Mandatory Standard of Higher Education approved by the Order of the Ministry of Education and Science of the Republic of Kazakhstan No. 604 dated 31.10.2018; in accordance with the Rules for organizing the educational process on credit technology of training, in accordance with the Professional Standard "Organization and operation of electrical equipment of a thermal power plant" (Appendix No. 33 to the order of the Deputy Chairman of the Board The National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" dated 18.12.2019 No.255.); recommendations and wishes of external stakeholders - potential employers were also taken into account (presentation webinar "Employer-UNIVERSITY-Future specialist" dated February 4, 2021 - Partner ENERGO LTD LLP, Semey, branch of VK REC JSC in Semey, Semipalatinsk Thermal Power Plant of the Eastern Intersystem Electric Networks branch of JSCKEGOS").

The MOS is designed as a set of sequential training modules for the entire period of study and is aimed at mastering the competencies necessary for awarding the Bachelor of Engineering and Technology degree in the educational program 6B07125 "Electric Power Industry".

The modules of the OOD block include disciplines of the mandatory component (OK) – 51 credits and elective components (VC) – 5 credits (Fundamentals of Market Economy and Entrepreneurship, Fundamentals of Law and Anti-Corruption Culture). All disciplines of the OOD block are common to all specialties of education, during the study of which the graduate must master the following competencies: general education, socio-ethical, communicative.

The DB block includes disciplines of the university component (VC) – 35 credits and elective components (CV) - 77 credits. Modules of these disciplines form a set of competencies: economic, organizational and managerial, communicative and professional.

The PD block includes disciplines of the university component (VC) -24 credits and elective components (CV) - 36 credits. Modules of these disciplines allow you to form a complex of special competencies acquired by a graduate. The criterion for the completion of the educational process is the student's mastering of 228 credits of theoretical training and IA - 12 credits. The MOS consists of 21 modules that ensure the achievement of the set goals.

The purpose of the modular educational program – efficient and safe distribution and use of energy resources. Power grid design, selection, installation and commissioning, diagnostics and maintenance of electrical networks. Development of devices involved in the production and consumption of electricity.

The requirements for the level of training of students are determined on the basis of the Dublin descriptors of the first level of higher education (bachelor's degree) and reflect the acquired competencies expressed in the achieved learning outcomes.

Expected results of the educational program. 6B07125 "Electric power industry":

ON 1: formulate mathematical methods of calculations and calculations, basic concepts of analytical geometry at a professional level; demonstrate knowledge and skills of using fundamental physical laws and theories, as well as methods of physical research; solve typical problems;

ON 2: To describe analytical and numerical analysis of electrical circuits under any influences in the time and frequency domain; to evaluate transients in linear circuits; to determine the parameters of four-poles under various operating modes; to analyze the transmission of energy over long lines

ON 3: To demonstrate knowledge of the documentation requirements adopted in professional communication; understanding of oral speech within professional topics; distinguish the necessary information from foreign-language sources;

ON 4: Analyze the structure of the electric power industry, the relationship between its various links, compare the technological process of electricity production at a power plant; solve practical problems related to the design of renewable and non-traditional energy sources; develop and correctly draw up technical and design documentation for renewable energy installations;

ON 5: Create diagrams and drawings based on the AutoCAD computer graphics program; choose methods for processing measurement results; evaluate measurement error in accordance with the standards and technical regulations of the Republic of Kazakhstan; select measuring instruments, organize measurement and evaluate the measurement result of various electrical quantities; use modern measuring instruments;

ON 6: Selection of basic and additional dielectric means of protection; first aid in case of electric shock; determination of safety procedures during operation of electrical installations, admission to work and supervision during work in electrical installations up to and above 1000 V;

ON 7: Calculate and describe the physical processes occurring in electrical circuits; evaluate the efficiency and choose the type of electrical devices for specific conditions; conduct elementary tests of electrical devices; describe the preliminary calculation of parameters and selection of electrical devices; calculate typical electrical calculations for various types of protections and automation, for specific electrical networks choose the type of relay protection devices; compile and analyze relay protection schemes, perform maintenance, control and verification of relay protection devices;

ON 8: Calculate the steady-state modes of open electrical networks; solve the steady-state modes of closed electrical networks; analyze the modes of a section of the electrical network; select a set of electrical installations for the transmission and distribution of electrical energy, consisting of substations, switchgear, current lines, overhead and cable transmission lines;

ON 9: To calculate short-circuit currents in networks with voltages up to and above 1000 V, to assess the effects of transients on the stability of the energy system; to interpret the economic characteristics of the types of production; to analyze and calculate the duration of the production cycle; to analyze the circuits of the electrical connections of the RC under various operating modes; to calculate and select the main elements of the electrical part of the stations and substations; offer a rational layout of electrical equipment for open and closed switchgears; analyze and select the main circuits of power plants; select electric motors for working mechanisms and check them according to the conditions of start-up and self-start;

ON 10: Calculate lighting and colorimetric calculations and measurements; select the methods necessary for measurements; predict regulated levels of electromagnetic compatibility by steady-state voltage deviation; determine parameters and characteristics of electronic devices and devices; measure electrical quantities in semiconductor devices;

ON 11: Determine the design parameters of electric machines and transformers; calculate and build static and operating characteristics of machines; interpret the electrical circuit of the machines; calculate the magnetic circuits of electric machines; explain the nature of electromagnetic processes; determine the design parameters in the EP system; calculate and build static and operating characteristics of machines; make electrical control circuits of the EP; calculate the given moments of inertia and forces in the EP;

ON 12: To select power electrical equipment and control circuits of electrical installations in accordance with environmental conditions; to install, adjust, evaluate the effective use and maintenance of power supply facilities and systems; to determine the properties of insulating, dielectric, conductive, semiconductor magnetic, electrical materials; to use electromechanical, electronic and microprocessor automation tools to control the values of electrical quantities for the purpose of managing electric power facilities; choose the means of automation of energy facilities;

ON 13: Describe the technical characteristics of electrical equipment; predict equipment malfunctions and take measures to prevent and eliminate them; calculate the electrical strength of the simplest insulation structures; apply methods to protect various electrical equipment from external and internal overvoltages;

ON 14: analyze the capabilities and select a microcontroller for process control, describe an algorithm and a program for process control; calculate and select the main elements of the circuits of power converting devices; make a preliminary calculation of parameters and select a serial converter for a specific application;

ON 15: Systematize, summarize legal and economic information for use in professional, including entrepreneurial activities. Analyze, summarize economic information and systematize safety standards for use in professional activities.

In order to create special conditions for people with special educational needs to receive education, the graduate's competence model is supplemented with professional competencies that ensure the adaptive nature of the main educational program. For this purpose, courses for the formation of the ability of persons with special educational needs to successfully socialize in society and actively adapt to the labor market, taking into account the characteristics of the disease, are introduced into the catalog of courses of the additional educational program "Minor".

2. The graduate's competence model

In modern conditions, the key resource of the country's economic growth is the intellectual and educational potential. In this regard, the system of training highly qualified personnel is becoming important.

The competitiveness of a specialist is determined by his professional competence, broad social outlook, flexibility of behavior and a high level of individual

activity.

The competence-based approach in higher professional education opens up wide opportunities for better training of specialists for real life.

The competence of the graduate is formed taking into account the needs of satisfaction of the labor market.

A graduate of the educational program 6B07125 Electric Power Engineering is awarded the academic degree Bachelor of Engineering and Technology under the educational program 6B07125 Electric Power Engineering.

Competencies that a graduate should have after mastering the MEP

Competence of general education:

- aimed at forming the ideological, civil and moral positions of the future specialist, competitive on the basis of knowledge of information and communication technologies, building communication programs in Kazakh, Russian and foreign languages, orientation to a healthy lifestyle, self-improvement and professional success;
- form a system of general competencies that ensure the socio-cultural development of the personality of the future specialist on the basis of the formation of his ideological, civil and moral positions;
- develop the ability to interpersonal social and professional communication in Kazakh, Russian and foreign languages;
- contribute to the development of information literacy through the mastery and use of modern information and communication technologies in all areas of their lives and activities;
- form skills of self-development and education throughout life;
- form a personality capable of mobility in the modern world, critical thinking and physical self-improvement;
- to evaluate the surrounding reality on the basis of worldview positions formed by knowledge of the fundamentals of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical cognition, to reveal the meaning of the content and specific features of the mythological, religious and scientific worldview;
- to show a civic position based on a deep understanding and scientific analysis of the main stages, patterns, peculiarities of the historical development of Kazakhstan, to use methods and techniques of historical description to analyze the causes and consequences of events in the history of Kazakhstan;
- assess situations in various spheres of interpersonal, social and professional communication, taking into account basic knowledge of sociology, political science, cultural studies, psychology, arguing their own assessment of everything happening in the social and industrial spheres, as well as synthesize knowledge of these sciences as a modern product of integrative processes;
- to use scientific methods, methods of research of a specific science, as well as the entire socio-political cluster, to choose a methodology, analyze and summarize the results of the study;
- to develop their own moral and civic position on the basis of social, business, cultural, legal and ethical norms of the Kazakh society;
- to put into practice knowledge in the field of social sciences and humanities, which has worldwide recognition, synthesize new knowledge and present it in the form of humanitarian socially significant products;
- to engage in communication in oral and written forms in Kazakh, Russian and foreign languages, using linguistic and speech means based on grammatical knowledge to solve the problems of interpersonal, intercultural and industrial (professional) communication, as well as to analyze information, actions and deeds of communication participants in accordance with the communication situation;
- to use various types of information and communication technologies in personal activities: Internet resources, cloud and mobile services for the search, storage, processing, protection and dissemination of information;
- to build a personal educational trajectory throughout life for self-development and career growth, to focus on a healthy lifestyle to ensure full-fledged

social and professional activities through methods and means of physical culture;
- to know and understand the basic laws of the history of Kazakhstan, the basics of philosophical, socio-political, economic and legal knowledge, communication in oral and written forms in Kazakh, Russian and foreign languages;
- apply the acquired knowledge for effective socialization and adaptation in changing socio-cultural conditions, possess the skills of quantitative and qualitative analysis of social phenomena, processes and problems.

Professional competencies:

To know:

- basic definitions in the field of natural sciences that contribute to the formation of a highly educated person with a broad outlook and thinking;
- basic concepts of higher mathematics and their applications in various fields;
- fundamental concepts, laws and theories of classical and modern mathematics, techniques and methods for solving specific problems;
- mathematical methods, mathematical intuitions, mathematical cultures;
- the essence of the basic concepts, laws, theories of classical and modern physics in their internal interrelation and integrity, the concept of physical laws, the limits of their applicability, allowing effective use in specific situations.
- basic laws of DC electrical circuits; basic laws of sinusoidal current electrical circuits;
- the basic laws that allow analyzing transients in linear electrical circuits both from the qualitative and quantitative side;
- ESCD standards, competently and concisely depict the simplest geometric shapes on the plane.
- structures of the State Standardization System (GSS) methodological bases of standardization, technical documentation systems, standards for electrical circuits, electrical machines, transformers, converters and other equipment, general norms in the electric power industry;
- general laws and rules of measurement, methods and means of measurement, measurement errors and laws of their distribution, methods of processing measurement results, technological processes.
- development trends, principles of construction and features of the application of modern computer technologies in the electric power industry and electrical engineering.

Be able to:

- build mathematical models, set mathematical problems, select suitable mathematical methods and algorithms for solving the problem, apply numerical methods using modern computer technology to solve the problem;
- to conduct qualitative mathematical research on the basis of the conducted mathematical analysis to develop practical recommendations;
- to solve generalized typical tasks of the discipline (theoretical and experimental-practical training tasks) from various fields of physics features;
- solve professional tasks;
- simulate physical situations using a computer;
- use methods of analysis and evaluation of experimental results.
- apply methods for calculating DC and sinusoidal current circuits;
- analyze the occurrence of abnormal modes of the power system and ways of their automatic detection and rapid elimination of the impact on the equipment of the power system
- to investigate various modes in three-phase circuits; to calculate transients in linear circuits with a single energy storage;
- read, determine the geometric shapes of simple parts from their images and perform these images both from nature and from a drawing;
- analyze measurement schemes of various physical quantities, determine measurement errors and creatively apply knowledge in the learning process.

Possess skills:

- solutions of professional tasks;
- assessment of the degree of reliability of the results obtained using experimental or theoretical research methods;
- conducting a physical experiment;
- using the achievements of fundamental science for the successful study of general theoretical and special technical disciplines, the development of mathematical thinking and logic.
- analytical and numerical analysis of electrical circuits under any influences in the time and frequency domain, including with the use of modern software tools.
- Drawing up various electrical circuits, analyzing the experimental data obtained and formulating appropriate conclusions.
- in working with design documentation, in drawing up drawings and diagrams of products for various purposes; work in modern engineering programs;
- practical application of standards to electrical circuits, electrical machines, transformers, converters and other equipment, knowledge of general standards in the electric power industry.
- work with control and measuring equipment for control; determination of metrological security of production; use of reference literature.
- work with raster, two-dimensional and three-dimensional vector graphics software to use the basic functionality of modern graphics systems; organization of dialogue in graphics systems.

Special competencies:

To know:

- physical phenomena occurring in electrical devices; the device and design features of various electrical devices, the principle of their operation; the main characteristics and parameters of electrical devices;
- about the dangerous and harmful effects of electric current on the body;
- possible sources of electric shock and assessment of their danger;
- structures of measuring devices, methods of measuring electrical quantities (small and large currents and voltages);
- the technology of energy production based on renewable energy sources; the program for the development of non-traditional energy in Kazakhstan;
- electric drive systems; electromechanical processes in the engine - working machine system;
- legislative and regulatory acts of labor protection and preservation of human health in the course of his work;
- current trends in the development of the organization and planning of production, enterprise management, as well as the tasks of further improving the organizational and economic training of specialists;
- the principle of operation and design features of electronic devices;
- magnetic and electromagnetic processes in electric machines;
- basic laws of light interference and diffraction, patterns of light propagation in isotropic and anisotropic media;
- basic principles of construction of control and control circuits of electrical installations;
- classification of modern materials in the electric power industry, their behavior in the electromagnetic field and under the influence of various factors, properties of materials, their application, testing methods and determination of the main characteristics of the most common electrical materials;
- methods of analytical and experimental research of static and dynamic characteristics of control objects;
- principles of conversion of renewable energy sources into thermal, mechanical and electrical energy.
- technical and organizational issues of installation, commissioning and operation of electrical installations of industrial enterprises;
- fundamentals of the theory of transients occurring in the power system and power supply system both during normal operation (switching on and off loads, power supplies, individual circuits, etc.) and in emergency situations (short circuit, breakage of a loaded circuit or its separate phase, loss of a

synchronous machine from synchronism, etc.);
- methods of minimizing conductive electromagnetic interference in electric power systems that ensure electromagnetic compatibility of technical means;
- normal, emergency and special modes of operation of electrical equipment;
- ways to eliminate abnormal modes and actions of operational personnel in the event of violations in the operation of the main and auxiliary equipment of the EES;
- design and operation of the main electrical equipment of stations and substations, fundamentals of the theory of electrical devices;
- physical fundamentals of electromechanical and electrical energy conversion, the device and principle of operation of DC and AC electric drives;
- basic information about electrical receivers and power supplies of an industrial enterprise;
- determine the calculated electrical loads and select standard electrical equipment;
- perform calculations of working and post-accident modes of power supply schemes of industrial enterprises;
- methods of distribution of electric energy on the territory of the enterprise with a voltage of 6-10 kV;
- basic principles of the choice of thermal mechanical equipment;
- the device and the principle of operation of modern power semiconductor elements;
- the device and the principle of operation of semiconductor converters used in electric drive;
- the main legislative and regulatory documents of the Republic of Kazakhstan on energy saving.

Be able to:

- perform an analysis of the capabilities of applied software tools and effectively apply them in the professional activity of the electric power industry;
- analyze and describe the physical processes occurring in electrical circuits
- work with normative and reference literature;
- perform engineering calculations on electrical safety issues;
- select measuring instruments, organize measurement and evaluate the result of measuring various electrical quantities;
- work in the environment of systems of non-traditional energy sources;
- use mathematical methods in calculations of normal modes of power systems;
- determine the design parameters in the EP system;
- to increase the technogenic safety of systems and to anticipate and eliminate emergencies;
- organize production maintenance;
- perform typical electrical calculations and determine installations for various types of protection and automation;
- experimentally determine the parameters and characteristics of electronic devices and devices;
- determine the design parameters of electrical machines and transformers;
- to make lighting and colorimetric calculations and measurements;
- correctly assess the feasibility of choosing and using electrical materials, work on laboratory equipment;
- apply electromechanical, electronic and microprocessor automation tools to control the values of electrical quantities in order to control electric power facilities;
- simulate and investigate a dynamic system using analog and digital computing technology;
- solve practical problems related to the design of installations of renewable and non-traditional energy sources.
- select power electrical equipment and control circuits of electrical installations in accordance with environmental conditions;

- calculate regulated levels of electromagnetic compatibility by the steady-state voltage deviation, by the coefficient of distortion of the sinusoidal voltage curve, by the coefficient of temporary switching overvoltage;
- select filter compensating installations and nonlinear surge limiters, place them in power supply systems for general and local purposes;
- to check the permissibility of switching on generators for parallel operation by means of precise synchronization and self-synchronization; to evaluate the success of self-starting of electric motors;
- perform analysis of the electrical connection diagrams of the RC under various operating modes;
- to test and remove, and calculate the characteristics of DC machines, asynchronous motor and synchronous machine;
- to determine the adjusting properties of electric motors of various types;
- determine the calculated electrical loads and select standard electrical equipment;
- perform calculations of working and post-accident modes of power supply schemes of industrial enterprises;
- analyze the processes of electricity metering;
- to make technical and economic calculations on the choice of power supply schemes and main and auxiliary equipment;
- calculate and select the main elements of the circuits of power converting devices;
- perform preliminary calculation of parameters and selection of a serial converter for a specific application;
- to describe and explain, on the basis of separate legislative and regulatory acts, the state policy on the efficient use of energy resources in the Republic of Kazakhstan.

Possess skills:

- on the choice of devices; on the maintenance of devices;
- application of regulatory materials on electrical safety issues;
- determine the main characteristics and parameters of electrical circuits and signals;
- in the calculation of modern energy conservation technologies;
- the use of modern computer technologies, mathematical packages and programming in the work.
- on the implementation of standard calculations and to determine the parameters and characteristics of individual elements of the electric drive;
- analysis of the causes of hazards and identify and eliminate failures of technical systems;
- on the development of the production process;
- verification of protections and installation of panels, cabinets and terminals of protections with the help of modern means of verification and adjustment;
- removing the main characteristics of semiconductor devices, amplifiers and determining the parameters of various electronic circuits, selecting the element base;
- information about the main parameters and characteristics of radiation frequency analyzers;
- educational design of electric machines based on existing general-purpose engine designs;
- on laboratory equipment to determine certain properties of electrical insulation materials;
- analysis of operating modes of electric power equipment and systems;
- methods of calculation of parameters and characteristics of automation means of electric power systems;
- design of various types of renewable and non-traditional energy sources, depending on external conditions.
- selection, installation, commissioning and operation of electrical installations of industrial enterprises;
- principles of conversion of electrical circuits of power supply systems;
- on solving problems of electromagnetic compatibility; on issues of electromagnetic compatibility in the electric power industry;

- on the construction of power diagrams and mapping of permissible loads of generators;
- calculation of technical characteristics and parameters of electrical equipment, selection of optimal circuit solutions in the design of power stations and substations;
- testing of electrical installations and experimental determination of their characteristics;
- testing and maintenance of electrical installations;
- repair and adjustment of electrical installations.
- methodology for calculating the stability, quality and reliability of electrical systems;
- the method of calculating electrical loads at the input of consumers;
- the latest achievements of digital technology of protection and automation of elements of the power system;
- the use of methods of analysis of power supply systems; the use of modern computational design tools;
- to use and analyze the use of resource-saving technologies in the organization of construction production.

Table 1. The sequence of mastering disciplines in the process of forming special competencies

№	Competencies	The list of compulsory, elective disciplines and the sequence of their study		Expected results
		List of disciplines	The sequence of their study (sem.)	
1	Special competencies	Installation and operation of electrical equipment of the power plant	5	**Know:** The rules of technical operation of power plants and networks; basic diagrams of electrical connections and other technological schemes of serviced power facilities; conducting rounds of equipment and workplaces of personnel servicing power plants; monitoring the operating mode and technical condition of equipment; conducting a survey of equipment, buildings and structures being repaired; elimination of identified defects, deviations from the requirements of the rules and instructions registration in the logs of identification and accounting; preparation of defective statements, work projects and other reporting, technological and design and repair documentation; execution of orders and orders for the execution of works.; **Be able to:** Organize the technical support of a full cycle or separate stages of operation of power plant equipment; prepare proposals for the implementation of organizational and technical measures aimed at optimizing operating modes, modernizing the design, improving the level of technical operation, efficiency of work and safety of equipment maintenance; preparation of a plan, schedule, inspection program; equipment repair maintenance, commissioning and testing, as well as maintaining schedules for his dismissal and inclusion (launch) in the work; **Possess skills:** Performing calculations to determine the need; registration and submission of an application for the decommissioning of equipment for diagnostic, commissioning, repair and other works for consideration by the management of the energy organization; execution of orders for the production of drawings, diagrams of design documentation, acquisition of regulatory and methodological documentation, manufacture of non-standard products; development of new equipment and advanced technologies of operation, tasks and technical means of automated control systems TP solutions; acceptance of equipment from repair and installation, verification of personnel knowledge; investigation of the causes of accidents and other technological violations, accidents; accounting and analysis of technical and economic performance indicators, defects in components, parts, equipment structures, the presence of emergency and fire-hazardous supply centers.
		Transients in the electric power industry / Electromagnetic and electromechanical processes	5	**Know:** the basics of the theory of transients occurring in the power system and power supply system both during normal operation (switching on and off loads, power supplies, individual circuits, etc.) and in emergency situations (short circuit, breakage of a loaded circuit or its separate phase, loss of a synchronous machine from synchronism, etc.). **Be able to:** to calculate short-circuit currents in networks with voltages up to and above 1000 V to acquire practical skills: assessing the impact of transients on the stability of the energy system. **Possess skills:** principles of conversion of electrical circuits of power supply systems
		Electromagnetic compatibility in the electric power industry / Electromagnetic compatibility of technical means	6	**Know:** methods of minimizing conductive electromagnetic interference in electric power systems that ensure electromagnetic compatibility of technical means. **Be able to:** calculate regulated levels of electromagnetic compatibility by steady-state voltage deviation, by the coefficient of distortion of the sinusoidal voltage curve, by the coefficient of temporary switching overvoltage; select filter-compensating installations and nonlinear surge limiters; place them in power supply systems for general and local purposes. **Possess skills:** to solve problems on electromagnetic compatibility; on issues of electromagnetic compatibility in the electric power industry.
				Know: normal, emergency and special modes of operation of electrical equipment; ways to eliminate abnormal modes and actions of operational personnel in the event of violations in the operation of the main and auxiliary equipment of the power plant;

				Be able to: check the permissibility of turning on generators for parallel operation by means of precise synchronization and self-synchronization; evaluate the success of self-starting electric motors. **Have skills:** to build power diagrams and draw up a map of permissible loads of generators; to determine the permissible operating time of generators in non-symmetrical modes.
		Electrical stations and substations / Electrical equipment of stations and substations	6	**Know:** the design and operation of the main electrical equipment of stations and substations, the basics of the theory of electrical devices. **Be able to:** analyze the circuits of the electrical connections of the RC under various operating modes; calculate and select the main elements of the electrical part of stations and substations; carry out a rational layout of electrical equipment of open and closed switchgear. **Possess skills:** calculation of technical characteristics and parameters of electrical equipment, selection of optimal circuit solutions in the design of power plants and substations.
				Know: fundamentals of the theory of electrical installations; general laws of physical processes in electrical installations; physical foundations of electromechanical and electrical energy conversion, the device and principle of operation of DC and AC electric drives, electromechanical properties of DC and AC electric motors, the device and principles of construction of electrical installations. **Be able to:** test and remove, and calculate the characteristics of DC machines, asynchronous motors and synchronous machines; determine the adjusting properties of electric motors of various types; compare technical and economic indicators of various electromechanical energy converters; **Possess skills:** testing electrical installations and experimental determination of their characteristics; testing and maintenance of electrical installations; repair and adjustment of electrical installations.
		Power supply / Power supply of electric power facilities	7	**Know:** terminology, basic concepts and definitions; basic information about electrical receivers and power sources of an industrial enterprise; methods for calculating electrical loads of electricity consumers; schemes, design and protective equipment for workshop networks with voltage up to 1000 V; purpose and features of electrical networks of in-plant power supply with voltage above 1000 V; basic electrical equipment of industrial enterprises; **Be able to:** determine the calculated electrical loads and select standard electrical equipment; perform calculations of working and post-accident modes of power supply schemes of industrial enterprises; perform technical and economic calculations of various options for power supply schemes of industrial enterprises. **Possess skills:** methodology for calculating the stability, quality and reliability of electrical systems; methodology for calculating electrical loads at the input of consumers; methodology for electrical calculation of internal wiring, overhead and cable transmission lines.
				Know: the main indicators for determining electrical loads; the principle of operation and design features of protective equipment; physical phenomena occurring during reactive power compensation; methods of distribution of electric energy across the territory of the enterprise with a voltage of 6-10 kV; characteristics of industrial consumers of electricity. **Be able to:** analyze the processes of electricity metering; evaluate the effectiveness of protective measures for electrical safety; calculate electrical loads by various methods. evaluate the effectiveness of protective measures for electrical safety; calculate electrical loads by various methods. **Possess skills:** in the latest achievements of digital technology of protection and automation of elements of power systems; methods and principles of construction of power lines.
		Design of power stations / Design of power supply systems	7	**Know:** the content and features of the design of power plants; the basic principles of the choice of thermal and mechanical equipment; the basic principles of the layout of power plants; the methodology for selecting the main circuits; methods for limiting short-circuit currents; methods for calculating short-circuit currents and conditions for choosing switching equipment and electrical apparatus; features of power supply schemes for own needs; design features of switchgear and control system

				design. **Be able to:** work with the initial data in the design; make technical and economic calculations for the selection of power supply schemes and main and auxiliary equipment; calculate short-circuit currents and check equipment for thermal and electrodynamic stability; analyze and select the main circuits of power plants, switchgear circuits and circuits for their own needs of power plants; select electric motors for workers mechanisms and check them according to the conditions of start-up and self-start. **Possess skills:** practical application of the acquired knowledge; use of methods of analysis of power supply systems; application of modern computational design tools; application of graphic programs to create design and technical documentation.
				Know: the main regulatory and technical documents adopted for management in the territory of the Republic of Kazakhstan; the main stages and sequence of designing power supply systems and nodes; modern calculation methods in the design; requirements for technical documentation; indicators of electricity quality. **Be able to:** determine electrical loads, reactive power compensation, technical and economic calculations, short-circuit currents, grounding; select the optimal power supply option; develop and execute design technical documentation. **Possess skills:** practical application of the acquired knowledge; use of methods of analysis of power supply systems; application of modern computational design tools; application of graphic programs to create design and technical documentation.
		Power converter devices / Energy saving and quality of electrical energy	7	**Know:** the device and the principle of operation of modern power semiconductor elements; the device and the principle of operation of semiconductor converters used in electric drive; physical phenomena occurring in semiconductor converters; the main parameters characterizing the operation of semiconductor converting devices; control methods to improve the quality of output voltage; methods of protection of semiconductor converters in emergency modes; principles of construction and operation of microprocessor control systems; programming tools of modern microcontrollers. **Be able to:** calculate and select the main elements of the circuits of power converting devices; make a preliminary calculation of parameters and the selection of a serial converter for a specific application; evaluate the capabilities and select a microcontroller for process control; make an algorithm and a program for process control; make a microcontroller connection diagram for automation tasks. **Possess skills:** to consolidate and concretize theoretical material concerning the principles of operation and device of various electrical measuring devices, their basic properties, methods of application, processing of observation results.
				Know: the main legislative and regulatory documents of the Republic of Kazakhstan on energy conservation; traditional and alternative types of energy; on ways to obtain new types of energy resources; on the energy balance of an industrial enterprise, the basics of tariff policy when using electric energy, on rationing energy consumption; on ways to reduce the consumption of electrical loads; rules for the rational use of electric energy. **Be able to:** describe and explain, on the basis of separate legislative and regulatory acts, the state policy on the efficient use of energy resources in the Republic of Kazakhstan. describe and explain the various processes underlying energy-saving technologies, give examples of energy-saving technologies in various industries, national economy. **Possess skills:** use and analyze the use of resource-saving technologies in the organization of construction production.

Table 2. Sequence of mastering disciplines of social and professional interaction

Course	Providing disciplines	Competencies	Expected result
General education disciplines			
Required component			
1	Modern History of Kazakhstan	Social and ethical competencies	**Know:** about the main sources and historical research; about the most important events of the XX and the beginning of the XXI centuries; about the development of Kazakhstan during the civil confrontation and in the conditions of the Soviet system; about the important stages of the formation of a sovereign and independent Kazakhstan the basic terms of historical science. **Be able to:** correlate common phenomena and individual historical facts; independently work with sources and historiography, prepare abstracts, essays and presentations; analyze and be able to evaluate significant historical events; explain their cause-and-effect relationships; think logically, freely discuss and defend their own opinion; explain the meaning and significance of basic historical concepts. **Possess skills:** working with sources, historiography and materials of periodicals and the Internet; writing abstracts, reports and essays; preparing and making presentations; compiling comparative tables; performing test and situational tasks; public speaking, conducting discussions and polemics.
1,2	Foreign language	Competencies in the field of languages	**Know:** vocabulary for communication within the framework of the subject under study; the structure of the main types of texts; **Be able to:** communicate in a foreign language within the framework of the topic being studied; express your thoughts about the problem being discussed using a variety of language tools. **Possess skills:** lexical and grammatical material on the subject; the ability to express their thoughts orally and in writing.
1,2	Kazakh (Russian) language	Competencies in the field of languages	**Know:** the features of the compositional and semantic organization of a scientific text; the main techniques for isolating the main information of the microtext; linguistic forms of expression of various types of information of a scientific text for solving problems of educational and professional communication; the principles of composing texts of the main educational, scientific, and professional genres; **Be able to:** formulate a topic, determine the linguistic means of organizing the text and use them when producing their own speech works; determine the types, volume and types of additional scientific information embedded in the text; compress the text as a basis for structural and semantic processing: create samples of secondary genres (plan, theses, synopsis, abstract, abstract, review, review) by comprehending and converting the source text; extract the necessary information from the primary source (mass media, official documents and scientific literature on the specialty), describe, summarize and interpret it for educational purposes. **Possess skills:** extract the necessary information from the text, describe it, generalize and interpret it in the process of educational and professional communication; develop a system of communicative skills; use special vocabulary in the main types of professional activity.
1	Information and communication technologies (in English)	Information and communication competencies	**Know:** economic and political factors of the development of information and communication technologies; features of various operating systems, architecture. **Be able to:** identify the main trends in the field of information and communication technologies; use information resources to search and store information; work with spreadsheets, consolidate data, build graphs; apply methods and means of information protection. **Possess skills:** develop a database structure; design and create presentations; receive data from the server; create video files; work with smartmart applications; work with services on the e–government website.

2	Philosophy	Social and ethical competencies	**Know:** the main stages, directions, teachings and problems of philosophy. **Be able to:** think philosophically competently, which is manifested in the ability to independently think through the most important philosophical topics. **Possess skills:** conceptual and categorical apparatus of philosophy, skills of analytical reading of philosophical texts, critical thinking.
1	Sociology	Social and ethical competencies	**Know:** the laws of development and functioning of society; features of the analysis of the modern system of social inequality, social mobility and stratification; possess: practical skills of independent analysis of the current state of society. to use basic knowledge in the field of humanities and economic sciences in cognitive and professional activities. **Be able to:** correlate the knowledge of the basics of sociology with professional activity; possess: practical skills of applying the knowledge gained in analyzing real social situations. **Possess skills:** basic terms and problems of sociology; basic sociological concepts.
1	Political Science	Social and ethical competencies	**Know:** the subject and objectives of the course; the main content of the course "political science"; to master the fundamental knowledge of political theory; the range of achievements of historical thought in the field of the study of ancient culture. **Be able to:** independently work with literature of a general humanitarian nature, be able to find nodal ideological problems and their solutions; think logically, systematically and critically; use the acquired baggage of philosophical erudition to formulate and prove their own judgments on various issues of everyday life. **Possess skills:** analysis of political statements and programs and political forecasting.
1	Cultural studies	Social and ethical competencies	**To know:** the structure and composition of modern cultural knowledge; cultural studies and philosophy of culture; sociology of culture, cultural anthropology; cultural studies and cultural history; **Be able to:** distinguish between the basic concepts of cultural studies: the dynamics of culture, language and cultural symbols, cultural codes, intercultural communication, cultural values and norms, cultural traditions, cultural worldview, social cultural institutions. **Possess skills:** ideas about the events of Kazakh and world culture based on the principle of respect and tolerance; skills of analyzing cultural sources; methods of conducting discussions and polemics
1	Psychology	Social and ethical competencies	**Know:** The essence of the main psychological processes and properties, mental states that provide a person with his vital activity; basic methods of psychology and be able to use them in the practice of activity, taking into account its economic specifics; psychological theories of personality, group and collective. **Be able to:** use the acquired knowledge of psychology in their practical activities; organize individual and group activities of people taking into account their psychological characteristics and compatibility; competently use communicative competence in the process of group joint activities. **Possess skills:** techniques for developing memory, thinking, analysis and generalization of information
Component of choice			
1	Fundamentals of market economy and entrepreneurship / Fundamentals of law and anti-corruption culture	Competence of general education	**Know:** the functions of money, the reasons for differences in the level of wages; the main types of taxes; organizational and legal forms of entrepreneurship; types of securities; factors of economic growth; the current state of the theory and practice of entrepreneurial activity; the specifics of entrepreneurial activity; **Be able to:** give examples of factors of production and factor incomes, public goods, Kazakhstani enterprises of various organizational forms, global economic problems; describe the operation of the market mechanism, the main forms of wages and labor incentives, inflation, the main articles of the state budget of Kazakhstan, economic growth, use the basic terminology of modern entrepreneurship; use methods of doing business;

			Possess skills: obtaining and evaluating economic information; drawing up a family budget; evaluating one's own economic actions as a consumer, family member and citizen.
	Fundamentals of market economy and entrepreneurship		**Know:** the essence of corruption and the causes of its origin, the measure of moral and legal responsibility for corruption offenses. **Be able to:** possess the skills to acquire new knowledge about the anti-corruption culture is an integral interdisciplinary knowledge system.
	Fundamentals of market economy and entrepreneurship / Basics of safety and life and ecology		**Know:** the functions of money, the reasons for differences in the level of wages; the main types of taxes; organizational and legal forms of entrepreneurship; types of securities; factors of economic growth; the current state of the theory and practice of entrepreneurial activity; the specifics of entrepreneurial activity; **Be able to:** give examples of factors of production and factor incomes, public goods, Kazakhstani enterprises of various organizational forms, global economic problems; describe the operation of the market mechanism, the main forms of wages and labor incentives, inflation, the main articles of the state budget of Kazakhstan, economic growth, use the basic terminology of modern entrepreneurship; use methods of entrepreneurial activity; **Possess skills:** obtaining and evaluating economic information; drawing up a family budget; evaluating one's own economic actions as a consumer, family member and citizen.
			Know: the legislative framework for life safety and environmental control, as well as methods for identifying, eliminating the influence of harmful factors on humans and the environment, and ensuring comfortable conditions for human life and activity; **Be able to:** systematize safety standards for use in professional activities; choose methods of protection from hazards in relation to the field of their professional activities and choose ways to ensure comfortable living conditions; **Possess skills:** ensuring the safety of life in industrial, domestic conditions and in emergency situations, the skills of first aid.
Basic disciplines			
University component			
3	Professional Kazakh (Russian) language	Competencies in the field of languages	**Know:** scientific vocabulary and scientific constructions of a technical profile; rules for producing texts of different genres; speech norms of the technical sphere of activity; fundamentals of business communication. Be able to: choose language means, build statements taking into account literary norms and the communicative situation; isolate the logical and compositional structure of the scientific test, master oral public statements (message, report), analyze listened public speeches; to carry out communication of a professional nature; to use dictionaries and correctly interpret the information received from them about language units; to reproduce the read or listened text from the educational, professional, socio-cultural spheres, highlighting the necessary information and presenting it in a certain sequence. **Possess skills:** working with scientific and technical literature; independent search for scientific and technical information as the basis of professional activity; listening and fully understanding the information of an oral message presented at a normal pace, followed by the transmission of its content; conducting dialogues-inquiries and dialogues of conversations.
3	Professionally-oriented foreign language	Competencies in the field of languages	**Know:** functional features of oral and written texts of a scientific and technical nature in the specialty; requirements for documentation accepted in professional communication; strategies of communicative behavior in situations of professional communication. **Be able to:** understand oral speech within professional topics; participate in the discussion of topics related to the specialty; independently prepare and make oral messages on professional topics using multimedia technologies;

			extract the necessary information from foreign language sources created in various sign systems (text, table, graph, diagram, audiovisual series, etc.); annotate, abstract and present in the native language the main content of the literature on the specialty, if necessary using a dictionary; write messages, articles, theses, abstracts on professional topics. **Possess skills:** basic grammatical structures characteristic of oral and written professionally-oriented communication;
1	Mathematics I	Competencies of natural sciences	**Know:** basic mathematical definitions, theorems, and other theoretical information of the course "Mathematics I", as well as knowledge of the types of problems solved by certain mathematical methods; **Be able to:** formulate applied practical problems using mathematical methods, as well as the use of known methods to solve formulated problems; **Possess skills:** independently or on the basis of educational training programs for advanced training in the field of mathematical knowledge in order to meet the modern requirements of the specialty
	Mathematics II		**Know:** properties of a function of several variables: (limitation, existence of the largest and smallest values, complex functions, partial increments and derivatives, full increments and differentials; basic methods of integrating double and triple integrals (substitution of variables, calculation in polar coordinates); types of differential equations and methods of their solution; decomposition of functions into power series and Fourier series; basic formulas for calculating the probabilities of random variables; **Be able to:** apply methods for solving differential and integral calculus of a function of several variables in applied problems; apply methods for solving differential equations in solving applied problems; obtain approximate values of solutions by decomposing into power series and Fourier series with a given accuracy; determine the optimal methods for solving practical problems; **Possess skills:** solving engineering problems using mathematical methods;
1	Physics	Competencies of natural sciences	**Know:** basic physical theories, laws and principles and their mathematical expression; the possibility of using theoretical knowledge to solve specific physical problems and situations; to know the basic laws and principles of physics; **Be able to:** mathematically display physical laws; apply theoretical knowledge to solve specific physical problems of the situation; identify the physical essence of phenomena and processes in devices of various physical nature and perform simple technical calculations with respect to them; work with measuring instruments, devices and instruments; perform graphical representations and perform statistical processing of data obtained during observations and measurement. **Possess skills:** the ability to work with measuring instruments, devices; - perform statistical processing of observation and measurement results and perform graphical representation.
2	Theoretical foundations of electrical engineering I	Professional competencies	**Know:** the basic laws of DC electrical circuits; the basic laws of sinusoidal current electrical circuits; circuits and formulas for calculating three-phase circuits; **Be able to:** apply the knowledge gained while studying the course "Theoretical Foundations of Electrical Engineering 1" to solve applied problems; apply methods for calculating DC and sinusoidal current circuits; investigate various modes in three-phase circuits; **Possess skills:** analytical and numerical analysis of electrical circuits under any influences in the time and frequency domain, including with the use of modern software.
2	Theoretical foundations of electrical engineering II	Professional competencies	**Know:** the basic laws that allow analyzing transients in linear electrical circuits from both the qualitative and quantitative side; the theory of four-pole and frequency electric filters; methods for calculating steady-state modes in linear electrical circuits with distributed parameters;

			Be able to: calculate transients in linear circuits with one energy storage device; calculate transients in linear circuits with two energy storage devices; determine the parameters of four-poles under different operating modes and select the parameters of frequency filters; analyze energy transmission over long lines; have an idea: about solving engineering problems using methods for calculating transients in linear electrical circuits; on solving engineering problems using the theory of four-poles; solve engineering problems using methods for calculating steady-state modes in linear electrical circuits with distributed parameters. **Possess skills:** drawing up various electrical circuits, analyzing the experimental data obtained and formulating appropriate conclusions.
Component of choice			
1	General Energy / World Energy	Professional competencies	**Know:** the structure of the electric power industry, the relationship between its various links, the technological process of electricity production at power plants; the main equipment of power stations and substations; the design of lines of electrical networks; the purpose and element base of relay protection; the composition of consumers in various industries; the principles of building schemes of external and internal power supply; voltage modes in the networks of industrial enterprises. **Be able to:** assess the condition and prospects for the development of power plants; choose the right cable products, protective equipment, required power supply schemes. **Possess skills:** in the calculation of modern energy conservation technologies.
			Know: the technology of energy production based on renewable energy sources; the program for the development of non-traditional energy in Kazakhstan; **Be able to:** work in the environment of systems of non-traditional energy sources; use modern achievements of science and technology; navigate in the constructive implementation of the main energy conversion devices. **Possess skills:** in the calculation of modern energy conservation technologies.
1	Descriptive geometry and engineering graphics using computers / Fundamentals of Computer Drawing	Professional competencies	**Know:** the basic projection models of mapping space to a plane, the apparatus of the two-, three-sided complex drawing of G. Monge, the laws of formation of flat and spatial forms, ways of constructing their images, the basic requirements of the ESCD (Unified system of design documentation); **Be able to:** perform AutoCAD diagrams and drawings based on a computer graphics system; read, solve problems on the mutual affiliation and mutual intersection of geometric shapes; determine the geometric shapes of simple parts from their images and perform these images both from nature and from the drawing of an assembly unit; read drawings of assembly units; **Possess skills:** practical work with drawing tools; reading images of objects, drawings of parts and assembly units of medium complexity; performing sketches and working drawings of parts, assembly drawings and general drawings; measuring parts and dimensioning on drawings of parts and assembly units; using information and reference materials and sources; perception of design documentation as production document; thinking with spatial images.
1	Metrology and Standardization / Fundamentals of Metrology	Professional competencies	**Know:** the legislation and standards of the Republic of Kazakhstan in the field of standardization, metrology, certification and international ISO standards; verification, standardization, quality control of products in one industry in the context of modern development of production, distribution and use of all types of energy; metrological support of measurements; mastering methods and measuring instruments; to be able to study the results of measurement and control, reliability and accuracy of measuring instruments and systems. **Be able to:** methods of processing measurement results; be able to estimate measurement error; **Possess skills:** types of measurements, measuring instruments and measurement errors; general principles and methods of measuring measurement results and measurements of thermal engineering quantities; master the basics

			of evaluation and verification of measuring instruments in accordance with the standards and technical regulations of the Republic of Kazakhstan.
			Know: terms and definitions, the international system of units of measurement SI, general laws and rules of measurement, methods and means of measurement, measurement errors and laws of their distribution, methods of processing measurement results, technological processes. **Be able to:** analyze measurement schemes of various physical quantities, determine measurement errors and creatively apply knowledge in the learning process. **Possess skills:** working with control and measuring equipment for control; determining the metrological security of production; using reference literature.
2	Basics of electric drive / Adjustable electric drive in the electric power industry	Professional competencies	**Know:** the composition of the electric drive; electric drive systems; electromechanical processes in the engine - working machine system; tasks implemented in the electric drive; how to convert a real EP system into a reduced one; energy modes of operation in the EP system; methods of starting and braking of the EP; operation of electrical control circuits of the EP; load modes of operation of the EP. **Be able to:** determine the design parameters in the EP system; calculate and build static and operating characteristics of machines; make electrical control circuits of the EP; calculate the given moments of inertia and forces in the EP; explain electromechanical processes in the EP; choose the necessary type and power of the engine; apply and make load diagrams of the EP; perform the necessary calculations related to all sections of the EP. **Possess skills:** to perform standard calculations and determine the parameters and characteristics of individual elements of the electric drive; to calculate load diagrams.
2	Electrical measurements in electrical installations / Measurement of electrical and non-electrical quantities	Professional competencies	**Know:** structures of measuring devices, methods of measuring electrical quantities (small and large currents and voltages, phase shift angle, power, energy); theory of measurement errors; basic concepts of processing the data obtained during measurement in order to obtain reliable results. **Be able to:** choose measuring instruments, organize measurement and evaluate the result of measuring various electrical quantities; use modern measuring instruments. **Possess skills:** to determine the main characteristics and parameters of electrical circuits and signals; to remove the main characteristics of electronic devices and microcircuits, the main characteristics of amplifiers (amplitude-frequency, phase-frequency, amplitude) and to determine the parameters of various analog circuits, the choice of the element base, the use of measuring instruments in various practical areas
2	Electrical safety in electrical installations / Safety in electrical installations	Professional competencies	**Know:** about the dangerous and harmful effects of electric current on the body; about the means of collective and individual protection of the employee; to learn how to apply the acquired knowledge practically; **Be able to:** work with normative and reference literature; get the amount of knowledge corresponding to at least the second qualification group of electrical safety admission. **Possess skills:** application of regulatory materials on electrical safety issues. the use of basic and additional insulating dielectric means of protection; first aid in case of electric shock.
			Know: possible sources of electric shock and an assessment of their danger. the most important technical requirements that ensure work related to electricity; fundamentals of electrical safety organizational and technical measures to ensure the safety of work in the EC; classification of insulating means of protection; **Be able to:** perform engineering calculations on electrical safety issues. analyze the danger of electrical networks; provide access to work in the EC voltage up to 1000 V; **Possess skills:** application of regulatory materials on electrical safety issues. the use of basic and additional insulating dielectric means of protection; first aid in case of electric shock.
3	Switching of electrical	Professional competencies	**Know:** physical phenomena occurring in electrical devices; the device and design features of various electrical

	devices / Electrical and electronic devices		devices, the principle of their operation; the main characteristics and parameters of electrical devices. **Be able to:** analyze and describe the physical processes occurring in electrical circuits; evaluate the efficiency and choose the type of electrical devices for specific conditions; independently conduct elementary tests of electrical devices; make a preliminary calculation of parameters and selection of electrical devices. **Possess skills:** to perform calculations; to select devices; to maintain devices; research work on the study of operating modes.
3	Electrical Systems and Networks / Electric Power Industry	Professional competencies	**Know:** schemes of electric power systems and networks, design of overhead and cable transmission lines; basic mathematical relations characterizing the operation of electric power systems; **Be able to:** apply, operate and select equipment for electric power systems and networks. **Possess skills:** methods of analyzing the operating modes of electric power systems; methods of calculating the parameters of electric power networks and systems, research skills.
3	Fundamentals of business activity in the electric power industry/ Organization and planning of energy enterprises	Professional competencies	**Know:** current trends in the development of the organization and planning of production, enterprise management, as well as the tasks of further improving the organizational and economic training of specialists; the history of the development of entrepreneurship in Kazakhstan; the economic policy of the state in relation to entrepreneurship in Kazakhstan and in other countries. subjects and objects of entrepreneurial activity in the energy sector; types and forms of entrepreneurial activity; external and internal business environment; conditions for entrepreneurial activity; motivation of an entrepreneurial decision and comparison with opportunities. **Be able to:** give an economic characteristic of the types of production; perform an analysis and calculation of the duration of the production cycle; build schedules for the organization of sequentially parallel, parallel assembly of products with and without synchronization of assembly units; perform calculations of the economic efficiency of in–line production; organize production maintenance; organize technical preparation and control of the production process; perform an analysis of production and economic activity. **Possess skills:** to perform calculations of the economic efficiency of in-line production, cost, pricing, profitability; to develop the production process.
3	Electrical equipment / Electromechanics and electrical equipment	Professional competencies	**Know:** the physical basics of electromechanical and electrical energy conversion, the design and principle of operation of DC and AC electric machines, the electromechanical properties of DC and AC electric motors, the design and principles of electromechanical systems; types and operating conditions of electrical insulation, classification and arrangement of high-voltage insulation structures, classification of cable products and materials used in cables. **Be able to:** perform the calculation of induction heating installations, determine the optimal operating modes of an arc steel furnace; perform color calculations, thermal calculation of lighting devices, calculation of lighting systems; **Possess skills:** to conduct a generalized calculation of the scheme of the mechanical part of the electric drive; to choose an electric drive system for production mechanisms, to choose the power of engines under different operating modes.
4	Fundamentals of Electric lighting / Lighting equipment and lighting	Professional competencies	**Know:** basic laws of interference and diffraction of light; laws of light distribution in isotropic and anotropic media; basic terms used in light and optical measurements; basic principles and methods of lighting and optical measurements; prospects for improving measurement methods; **Be able to:** carry out lighting and colorimetric calculations and measurements; choose the methods necessary for measurement; **Possess skills:** skills of working with literary sources and Internet sites; working with graphic programs; information about the main parameters and characteristics of radiation frequency analyzers; basic methods of

			processing and presenting experimental data; performing experience in lighting and colorimetric calculations;
4	Transmission and distribution of electric energy / Transmission of electric energy by direct and alternating current	Professional competencies	**Know:** electrical networks of 6-10 kV of higher harmonics, to static equipment, electrical machines, phase-to-ground currents, general-purpose electrical machines of technical means in the network influence on the level of compatibility; **Be able to:** calculate high current and voltage harmonics generated by a nonlinear load, select and refine filtering compensation installations and place them in public power supply systems; **Possess skills:** the necessary skills to determine higher harmonics in networks with nonlinear loads.
4	Relay protection and automation / relay protection of electrical installations	Professional competencies	**Know:** the causes of abnormal modes of the power system and ways of their automatic detection and rapid elimination of the impact on the equipment of the power system: device, principle of operation, properties, scope of application of the main elements of protection devices and automation; **Be able to:** perform standard electrical calculations and determine setpoints for various types of protection and automation; select a sufficient and necessary number and type of relay protection devices for specific electrical networks; compile and analyze relay protection circuits, perform maintenance, control and verification of relay protection devices; **Possess skills:** protection checks and installation of panel linings, cabinets and terminals with the help of modern inspection and repair tools
4	Safety and operating regulations / Labor protection in the electric power industry	Professional competencies	**Know:** legislative and regulatory acts on labor protection and human health protection in the course of his work; equipment and technological processes, as well as methods of ensuring their safe operation; methods of risk analysis and ensuring stable operation and the procedure for detecting failures of technical systems; **Be able to:** increase the technogenic safety of systems and anticipate and eliminate emergencies; assess the level of risk during operation of equipment and technological lines; eliminate technological failures during operation of equipment; **Possess skills:** analyze the causes of danger and identify and eliminate failures of technical systems;
Profile disciplines			
Required component			
2	Basics of Electronics	Professional competencies	**Know:** the principle of operation and design features of electronic devices; physical phenomena occurring in electronic devices; the main characteristics of electronic devices. **Be able to:** experimentally determine the parameters and characteristics of electronic devices and devices; make measurements of electrical quantities in semiconductor devices. **Possess skills:** removing the main characteristics of semiconductor devices, amplifiers and determining the parameters of various electronic circuits, selecting the element base
3	Electric machines	Professional competencies	**Know:** the purpose and design of collector and non-collector machines; excitation systems, switching circuits of DC machines; replacement circuits of asynchronous machines; magnetic and electromagnetic processes in electric machines; methods of starting electric machines; operating characteristics of electric machines; normal, emergency, experimental modes of operation; electromagnetic processes, transformer design; history of the development of electrical cars; **Be able to:** determine the design parameters of electric machines and transformers; calculate and construct static and operating characteristics of machines; make an electrical circuit of machines; calculate magnetic circuits of electric machines; explain the nature of electromagnetic processes; apply the latest achievements of science in the study of the discipline; use technical information materials. **Possess skills:** educational design of electric machines based on existing general-purpose engine designs; performing calculations of operating parameters of machines and transformers; research work on the study of

			modes, analysis of modes of machines and transformers; calculating energy costs.
Component of choice			
2	Electrical Materials science / Materials in the electric power industry	Professional competencies	**Know:** the classification of modern materials in the electric power industry, their behavior in the electromagnetic field and under the influence of various factors, the properties of materials, their application, testing methods and determination of the main characteristics of the most common electrical materials. **Be able to:** correctly assess the feasibility of choosing and using electrical materials, work on laboratory equipment. **Possess skills:** on laboratory equipment to determine certain properties of insulating materials; on laboratory equipment to determine certain properties of dielectric materials; on laboratory equipment to determine certain properties of conductive materials; on laboratory equipment to determine certain properties of semiconductor materials; on laboratory equipment to determine certain properties of semiconductor materials; on laboratory equipment to determine certain properties magnetic materials; when solving problems to determine the parameters of electrical materials.
3	Alternative energy sources / Alternative energy	Professional competencies	**Know:** the technology of energy production based on renewable energy sources; the program for the development of non-traditional energy in Kazakhstan. **Be able to:** work in the environment of systems of non-traditional energy sources; use modern achievements of science and technology; navigate in the constructive implementation of the main energy conversion devices. **Possess skills:** in the calculation of modern energy conservation technologies.
3	Automation of electric power facilities / Fundamentals of automatic control	Professional competencies	**Know:** the basic principles of building control and control circuits of electrical installations; the basic essence of control and tasks solved within the framework of automated control systems by electrical installations; general information about automated control systems, functions, composition and structure of automated control systems; problems of ensuring static stability of parallel operation of power plants in established normal and post-emergency modes and the need to maintain dynamic stability under electromagnetic and electromechanical transients in emergency mode; the history of development, scope of application and innovative trends in improving the automation of power plants, substations and electric power systems; **Be able to:** apply electromechanical, electronic and microprocessor automation tools to control the values of electrical quantities in order to control electric power facilities; use modern information and telecommunication technologies in the design and technological preparation of automation complexes to increase the reliability, sensitivity and selectivity of automation tools; choose and implement effective modes of operation of automation tools according to specified methods; properly operate the tools automation of energy facilities; **Possess skills:** methods of calculating parameters and characteristics of automation of electric power systems; application of modern computer technologies for obtaining information in the field of automation of electric power systems; methods of designing subsystems of automation of electric power systems; work with reference literature and regulatory and technical materials; conducting standard tests and adjustment of automation of electric power systems; practical preparation of technical specifications for the design of automation systems (including automated control systems) of electric power systems, power stations and substations.
			Know: methods of analytical and experimental research of static and dynamic characteristics of control objects; methods of compilation and linearization of mathematical models of dynamic systems; methods of stability analysis of dynamic systems. **Be able to:** model and investigate a dynamic system using analog and digital computing technology; analyze the stability and quality indicators of the automatic control system. **Possess skills:** about the principles of automatic control; about the main types of control systems; about the goals,

			objectives and methods of analysis and synthesis of automatic control systems.
	Overvoltage and isolation in power supply systems / isolation and overvoltage in electric power systems	Professional competencies	**Know:** the main operational characteristics of Ed insulation; methods of protection of various electrical equipment from external and internal overvoltages. **Be able to:** calculate the electrical strength of simple insulating structures. **Possess skills:** to choose the protection of the EC from overvoltage in matters of protection from power lines and substations.

Table 3. List of modules included in the educational program

Module No.	Name of the module	List of disciplines included in the module	Block	Term	Loan volume	Type of control	Total credits by module
M.1	History	Modern history of Kazakhstan	MC GED	2	5	SE	5
M.2	Communicative	Foreign language	MC GED	1,2	10	Exam	20
		Kazakh (Russian) language	MC GED	1,2	10		
M.3	Information and communication technologies	Information and communication technologies (in English)	MC GED	1	5	Exam	5
M.4	Social Studies	Philosophy	MC GED	4	2	Exam	10
		Sociology	MC GED	2	2		
		Political Science	MC GED	2	2		
		Cultural studies	MC GED	1	2		
		Psychology	MC GED	1	2		
M.5	Physical Culture	Physical Culture	MC GED	1-4	8	dif offset	8
M.6	Mathematics	Mathematics I	UK BD	1	4	Exam	7
		Mathematics II	UK BD	2	3		
M.7	Physical processes and electronics in the electric power industry	Physics	UK BD	2	5	dif offset	16
		Educational practice	UK BD	2	1	Exam	
		Theoretical foundations of electrical engineering I	UK BD	3	5	Exam	
		Theoretical foundations of electrical engineering II	UK BD	4	5		
M.8	Professional communicative	Professional Kazakh (Russian) language	UK BD	5	3	Exam	6
		Professionally-oriented foreign language	UK BD	5	3		
M.9	Energy	General Energy / World Energy	CS BD	3	3	Exam	8
		Alternative and renewable energy sources / Alternative energy	CS BD	5	5		
M.10	Graphics and standardization	Descriptive geometry and engineering graphics using computers / Fundamentals of Computer Drawing	CS BD	3	5	Exam	16
		Metrology and Standardization / Fundamentals of Metrology	CS BD	3	5		
		Electrical measurements in electrical installations / Measurement of electrical and non-electrical quantities	CS BD	4	4		
		Industrial practice I	CS BD	6	2	dif offset	
M.11	Electric machines and electric drive	Basics of electric drive / Adjustable electric drive in the electric power industry	CS BD	2	5	Exam	10
		Electric machines	UK PD	4	5		
M.12	Safety in electrical appliances	Fundamentals of market economy and entrepreneurship/Fundamentals of safety and life and ecology	UK GED	2	5	Exam	13
		Electrical safety in electrical installations / Safety in electrical installations	CS BD	4	4		
		Rules of technical safety and operation / Labor protection in the electric power industry	CS BD	8	4		
M.13	Electrical devices and relay protection	Switching of electrical devices / Electrical and electronic devices	CS BD	5	5	Exam	11

		Relay protection and automation / Relay protection of electrical equipment	CS BD	7	6		
M.14	Transients in the electric power industry	Electrical Materials science / Materials in the electric power industry	CS BD	4	3	Exam	17
		Electromagnetic compatibility in the electric power industry / Electromagnetic compatibility of technical means	CS BD	7	5		
		Transients in the electric power industry / Electromagnetic and electromechanical processes	CS BD	5	4		
		Overvoltage and isolation in power supply systems / Isolation and overvoltage in electric power systems	CS BD	7	5		
M.15	Силовые преобразовательные устройства	Power converter devices / Energy saving and quality of electrical energy	CS PD	8	6	Exam	14
		Industrial practice III	CS PD	8	5	dif offset	
		Pre-graduate practice	CS PD	8	3		
M.16	Entrepreneurship	Fundamentals of entrepreneurship in the electric power industry / Organization and planning of energy enterprises	CS PD	6	4	Exam	4
M.17	Installation, repair and operation of electrical equipment	Installation, repair and operation of electrical equipment	CS PD	5	5	Exam	13
		Electrical equipment / Electromechanics and electrical equipment	CS PD	6	6		
		Industrial practice II	CS PD	6	2	dif offset	
M.18	Electric stations and substations	Electrical stations and substations / Electrical equipment of stations and substations	CS PD	4	5	Exam	15
		Design of power stations and substations / Design of power supply systems	CS PD	7	5		
		Transmission and distribution of electricity / Transmission of electricity by direct and alternating current	CS PD	7	5		
M.19	Power supply and lighting	Power supply / Power supply of electric power facilities	CS PD	6	7	Exam	16
		Fundamentals of electric lighting / Lighting equipment and lighting	CS PD	7	4		
		Electrical Systems and Networks / Electric Power Industry	CS PD	5	5		
M.20	Electronics and automation	Basics of Electronics	CS PD	3	5	Exam	11
		Automation of electric power facilities / Fundamentals of automatic control	CS PD	6	6		
M.21	Final certification	Writing and defending a thesis (project) or preparing and passing a comprehensive exam	ATT	8	12	Exam	12