ALIKHAN BOKEIKHAN UNIVERSITY

MODULAR EDUCATIONAL PROGRAM
6B07125 ELECTRIC POWER INDUSTRY

Semey, 2024 y.

Developed by the Department of "Information and Technical Sciences"

Discussed and approved at the meeting of the Department of Information and Technical Sciences (Protocol No. 06 of 8.02.2024).

Reviewed and recommended for approval at a meeting of the Academic Quality Council of the Faculty (protocol No. 01 of 21.02.2024).

Reviewed and approved at the meeting of the Educational and Methodological Council of the University (Protocol No. 05 of 05/28/2024).

CONTENT

1 Explanatory note

The modular educational program is based on the following regulatory documents:

- The State standard of higher and Postgraduate education, approved by the Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No. 2;

- Rules for the organization of the educational process on credit technology of education, approved by the Order of the Minister of Education and Science of the Republic of Kazakhstan dated April 20, 2011 No. 152;

- Standard rules for the activities of organizations of higher and (or) postgraduate education, approved by the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No. 595;

- Professional standard - "Maintenance, installation and commissioning of electrical equipment", "Operation and repair of electrical equipment" approved by Order No. 255 of the Deputy Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" dated 12/18/2019.

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. All disciplines of the OOD block are common to all OP, during the study of which the graduate must master the competencies of general education.

The DB block includes disciplines of the university component (VC) – 35 credits and elective components (CV) - 77 credits. Modules of these disciplines form professional and special competencies

The PD block includes disciplines of the university component (VC) -27 credits and elective components (CV) - 37 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 232 credits of theoretical training and IA - 8 credits.

The MEP consists of 21 modules that ensure the achievement of the set goals. Heads and representatives of enterprises and organizations of the city took part in the discussion of the MEP. Recommendations and wishes of external stakeholders - potential employers were taken into account (presentation webinar "Employer-UNIVERSITY-Future specialist" dated February 6, 2024)

- Mukhanov B.M., Director of Partner ENERGO LTD LLP, Semey,
- Smagulov B.R., Head of the branch of JSC "OESK" Semey,
- K.M. Mubarakov, Head of the Semipalatinsk Thermal Power Plant of the Eastern Intersystem Electric Networks branch of KEGOS JSC.

The purpose of the modular educational program – Training of highly qualified specialists with in-depth knowledge and practical skills in the field of production, transmission, distribution and consumption of electric energy, improving the reliability and efficiency of energy systems, introducing innovative technologies and ensuring sustainable development of the energy sector.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 electrical circuits and drawings based on computer graphics programs; the ability to compile and execute standard technical documentation; know electrical circuits and rules for their application; use regulatory and guidance documents when drawing up electrical circuits; develop skills in developing and tracing electrical circuits;

ON 6: Apply electrical safety protective equipment, select basic and additional dielectric protective equipment; provide first aid in case of electric shock; determine the safety procedure for the operation of electrical installations, make work permits and supervise 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 Demonstrate knowledge about the idea of a modern rule of law in order to instill entrepreneurial skills , leadership, and receptivity to innovation based on scientific research in compliance with the principles of academic integrity , as well as ensuring safety standards.

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 (term)	
1	Special competencies	Theoretical foundations of electrical engineering I	3	**To know:** basic laws of DC electrical circuits; basic laws of sinusoidal current electrical circuits; schemes 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; explore different modes in three-phase circuits; **Possession skills:** analytical and numerical analysis of electrical circuits under any influences in the time and frequency domain, including with the use of modern software tools.
2	Special competencies	Basics of electric drive	3	**To 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 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 with all sections of the EP. **Possession skills:** to perform standard calculations and determine the parameters and characteristics of individual elements of the electric drive; to calculate load diagrams.
		Adjustable electric drive in the electric power industry		**To know:** modern methods and tools of practical engineering in solving problems in the field of electric power and electrical engineering; to know the principles of construction and mathematical description of automatic control systems of electric drives; to know the basic requirements for automated electric drives and ways to meet them; **Be able to:** formulate tasks in the field of electric power and electrical engineering, analyze and solve them using all the required and available resources; be able to apply the knowledge gained in the design of automated electric drive systems. **Possession skills:** applying modern methods and tools of practical engineering in solving problems in the field of electric power and electrical engineering; using analog and digital computing equipment; independently solve various issues in the field of automated electric drive during its

				design and operation in production.
3	Special competencies	Basics of Electronics	3	**To 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. **Possession skills:** removing the main characteristics of semiconductor devices, amplifiers and determining the parameters of various electronic circuits, selecting the element base
4	Special competencies	Theoretical foundations of electrical engineering II	4	**To 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-pole; solve engineering problems using methods for calculating steady-state modes in linear electrical circuits with distributed parameters. **Possession skills:** drawing up various electrical circuits, analyzing the experimental data obtained and formulating appropriate conclusions.
5	Special competencies	Electrical measurements in electrical installations	4	**To 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. **Possession skills:** to determine the main characteristics and parameters of electrical circuits and signals; removal of the main characteristics of electronic devices and microcircuits, the main characteristics of amplifiers (amplitude-frequency, phase-frequency, amplitude)
		Measurement of electrical and non-electrical quantities		**To know:** means of electrical measurements, technical means used in electrical measurements. **Be able to:** solve the problems of electrical measurements, which is finding the values of physical quantities experimentally using electrical means and expressing these values in the desired units. **Possession skills:** to determine the parameters of various analog circuits, the choice of the element base, the use of measuring instruments in various practical areas
6	Special competencies	Electrical drawings and diagrams	4	**To know:** rules of graphic representation of elements of electrical circuits; electrical terminology; types of electrical circuits; basic elements of electrical networks; power supply circuits; **Be able to:** read schematic, electrical and wiring diagrams; calculate the parameters of electrical

		Drawing and designing of electrical circuits		circuits; assemble electrical circuits. **Possession skills:** design and reading of design and technological documentation; rules for the execution of drawings, technical drawings, sketches and diagrams, geometric constructions and rules for drawing technical details ;Graphical representation of technological equipment and execution of technological schemes in manual and machine graphics; read drawings, technological schemes, specifications and technological documentation on the profile of the specialty. **To know:** designations for electrical circuits and rules for their application; content and purpose of structural, functional, schematic and wiring diagrams; **Be able to:** read and perform structural, schematic, functional and wiring diagrams of electrical devices; use regulatory and guidance documents when drawing up electrical circuits, use schematic diagrams for correct installation and troubleshooting; **Possession skills:** development and drawing of electrical circuits.
7	Special competencies	Electric machines	4	**To know:** 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 development electric machines; **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 the machines; calculate the 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. **Possession skills:** educational design of electric machines based on existing general-purpose engine designs; calculations of operating parameters of machines and transformers; research work on the study of modes, analysis of modes of machines and transformers; calculation of energy costs.
8	Special competencies	Electrical Materials Science	4	**To know:** 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. **Be able to:** correctly assess the feasibility of choosing and using electrical materials, work on laboratory equipment. **Possession skills:** on laboratory equipment for determining certain properties of insulating materials; on laboratory equipment for determining certain properties of dielectric materials; on laboratory equipment for determining certain properties magnetic materials; when solving problems to determine the parameters of electrical materials.

		Materials in the electric power industry		**To know:** Classification and basic properties of conductive materials; Classification of dielectrics by type of polarization; system of actions in various professional situations of the production site; analyze production situations; acquired skills; in the knowledge of theoretical knowledge on electrical materials in professional growth; classification of metals; the process of crystallization of metals; types of crystal lattices; properties of Fe-C alloys and non-ferrous metals; marking of steels and cast iron, non-ferrous metals and alloys; scope of application of alloys; **Be able to:** Distinguish between types of dielectric losses and factors affecting dielectric losses; analyze production situations Possession skills: solve physical problems, give quantitative estimates and performs calculations using formulas and equations.
9	Special competencies	Switching of electrical devices	5	**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. **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. **Possession skills:** for performing calculations; for selecting devices; for servicing devices; research work on the study of operating modes.
		Electrical and electronic devices		**To know:** Classification of electrical devices by purpose, scope, principle of operation, design features. **Be able to:** choose devices taking into account technical and economic indicators. **Possession skills:** formulate basic numerical methods for determining electrodynamic forces and indicate the area of the most rational application of each of them.
10	Special competencies	Electrical Systems and Networks	5	**To 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. **Possession skills:** methods of analyzing the operating modes of electric power systems; methods of calculating the parameters of electric power networks and systems, research skills.
		Electric Power		**To know:** principles of operation, technical characteristics and design features of the developed and used electric power facilities; **Be able to:** develop the principles of organization, design of enterprises and devices of the electric power industry;

		Industry		**Possession skills:** use application software packages for calculations, modeling and automation of design of electric power systems;
11	Special competencies	Transients in the electric power industry	5	**To know:** 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.). **Be able 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. Possession skills: principles of conversion of electrical circuits of power supply systems
		Electromagnetic and electromechanical processes		**To know:** methods of analysis of static and dynamic stability of electric power systems, as well as the main measures to ensure static, dynamic and resultant stability of systems. **Be able to:** make calculation schemes and corresponding substitution schemes with respect to the currents of the forward, reverse and zero sequences and determine the parameters of various elements of these schemes by different methods; **Possession skills:** calculations of transients in three-phase and asymmetric short circuits, as well as in phase interruptions; - know methods of analysis of static
12	Special competencies	Installation and operation of electrical equipment of the power plant	5	**To know:** 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 requirements 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:** Organization of technical support for the full cycle or individual stages of operation of power plant equipment; preparation of proposals for the implementation of organizational and technical measures aimed at optimizing operating modes, modernization of the design, increasing the level of technical operation, efficiency of work and safety of equipment maintenance; preparation of a plan, schedule, inspection program; repair of equipment maintenance, commissioning and testing, as well as maintaining schedules for his dismissal and inclusion (launch) in work; **Possession skills:** Performing calculations to determine the need; making and sending an application for the decommissioning of equipment for diagnostic, commissioning, repair and other work for consideration by the management of the energy organization; making orders for the production of drawings, diagrams of design documentation, the acquisition of regulatory and methodological documentation, the manufacture of non-standard products; development of new equipment and

				advanced technologies of operation, tasks and technical means of automated control system solutions; acceptance of equipment from repair and installation, checking the knowledge of personnel; investigation of the causes of accidents and other technological violations, accidents; accounting and analysis of technical and economic indicators of work, defects in components, parts, equipment structures, the presence of emergency and fire-hazardous supply centers.
13	Special competencies	Alternative and renewable energy sources	5	**To know:** the main alternative energy sources; - principles of processes for obtaining final types of energy from unconventional and renewable energy sources; **Be able to:** make calculations to evaluate the parameters of energy sources of energy, the density of energy flows; - calculations to determine the possible capacity of power generating plants, the main design parameters to assess the possibility of their construction; **Possession skills:** analysis of renewable energy resources, time characteristics of renewable energy sources, quality of energy sources. in the structure of global energy consumption
		Unconventional energy		**To 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. **Possession skills:** in the calculation of modern energy conservation technologies.
14	Special competencies	Fundamentals of entrepreneurship in the electric power industry	6	**To 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 entrepreneurship development 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; **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 andeconomic activity. **Possession skills:** for performing calculations of the economic efficiency of in-line production, cost, pricing, profitability; for the development of the production process.
		Organization		**To know:** Energy planning and finance in the field of energy conservation; - basic concepts and categories of economics, economic laws and patterns, economic systems, as well as the main stages of the development of economic theory; **Be able to:** solve the tasks of organizing and managing the production and economic activities of

		and planning of energy enterprises		enterprises, creating and implementing new technologies, a future energy engineer needs to have not only technical knowledge, but also economic; use the basic economic concepts and categories of economics in his professional activity; use the basic provisions and methods **Possession skills:** to form practical skills in solving applied problems in the field of planning production and economic activities of enterprises, as well as making managerial decisions in the field of investment projects; skills to improve their qualifications in economic terms, necessary in their professional activities; - skills of applying methods of economics in solving professional tasks
15	Special competencies	Electrical equipment	6	**To know:** the physical foundations 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; **Possession 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.
		Electromechanics and electrical equipment		**To know:** the structure of electrical equipment systems; types and principles of construction of switching stations.; PBX structure. Purpose and characteristics of the main elements.; basic concepts of direct and alternating electric current, serial and parallel connection of conductors and current sources, units of measurement of current strength, voltage, electric current power, resistance of conductors, electric and magnetic fields; **Be able to:** select electrical equipment and calculate its operating modes; monitor the parameters of electrical equipment; start and stop the electric motor installed on the equipment in operation; calculate parameters, make and assemble circuits for switching on devices when measuring electrical quantities, electrical machines and mechanisms; **Possession skills:** skills of work on automated electric power systems, converter devices, electric drives of power, technological and auxiliary installations, their automation systems, control and diagnostics;
16	Special competencies	Electric stations and substations	6	**To 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. **Possession skills:** calculation of technical characteristics and parameters of electrical equipment, selection of optimal circuit solutions in the design of power plants and substations.
		Electrical equipment of stations and substations		**To know:** fundamentals of the theory of electrical installations; general laws of physical processes in electrical installations; physical foundations of electromechanical and electrical energy conversion, device and principle of operation of DC and AC electric drives, electromechanical properties of DC and AC electric motors, 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; **Possession skills:** testing of electrical installations and experimental determination of their characteristics; testing and maintenance of electrical installations; repair and adjustment of electrical installations.
17	Special competencies	Automation of electric power facilities	6	**To 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; problems of ensuring static stability of parallel operation of power plants in steady-state normal and post-emergency modes and the need to maintain dynamic stability during electromagnetic and electromechanical transients in emergency mode; **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 reliability, **Possession 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;
		Basics of automatic control		**To 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; fundamentals of building automatic control systems; elementary base of controllers and ways of their programming; means of interaction of controllers with industrial networks; **Be able to:** simulate and investigate a dynamic system using analog and digital computing technology; analyze the stability and quality indicators of the automatic control system; use computer modeling methods to analyze and select the performance characteristics of automatic control systems; optimize the operation of electrical equipment; apply automation elements for

				their functional purpose **Possession 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; to make block diagrams of automation systems; to select sensors for selecting information about process parameters;
18	Special competencies	Power supply	6	**To 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 a voltage of up to 1000 V; purpose and features of electrical networks of in-plant power supply with a 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 variants of power supply schemes of industrial enterprises. **Possession 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.
		Power supply of electric power facilities		**To know:** basic indicators for determining electrical loads; operating principle and design features of protective equipment; -physical phenomena occurring during reactive power compensation; methods of distribution of electric energy on the territory of the enterprise with a voltage of 6-10 kV; characteristics of industrial electricity consumers. **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. **Possession 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.
19	Special competencies	Basics of electric lighting	7	**To know:** basic laws of light interference and diffraction; 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; **Possession 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;
		Lighting equipment and lighting		**To know:** methods and computer systems for designing and researching light, optical and laser technology, optical and lighting materials and technologies **Be able to:** formulate goals, objectives of scientific research or development in the field of lighting and photonic technologies, and materials, the ability to identify and justify the criteria on the basis of which decision-making models are formed, draw up a work plan **Possession skills:** To perceive, process, analyze and systematize scientific and technical information, advanced domestic and foreign experience in the field of light, optical and laser technology, optical and lighting materials science and optical and lighting technologies
20	Special competencies	Electromagnetic compatibility in the electric power industry	7	**To know:** methods for 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. **Possession skills:** on solving problems of electromagnetic compatibility; on issues of electromagnetic compatibility in the electric power industry.
		Electromagnetic compatibility of technical means		**To know:** normal, emergency and special modes of operation of electrical equipment; ways to eliminate abnormal modes and actions of operational personnel in case of violations in the operation of the main and auxiliary equipment of the power plant; **Be able to:** check the permissibility of switching on generators for parallel operation by means of precise synchronization and self-synchronization; evaluate the success of self-starting of electric motors. **Possession skills:** for constructing power diagrams and mapping permissible loads of generators; for determining the permissible operating time of generators in asymmetric modes.
21	Special competencies	Transmission and distribution of electrical energy	7	**To know:** electric networks of 6-10 kV of higher harmony, to static equipment, electric machines, phase-to-ground currents, general-purpose electric 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; **Possession skills:** the necessary skills to determine higher harmonics in networks with nonlinear loads.
		Transmission of electricity by		**To know:** schemes, constructive execution of DC electric machines of the repaired series; technologies of operation, diagnostics of the EPITHELIUM condition **Be able to:** calculate the volume and timing of repairs of electrical energy transmission, compile and

		direct and alternating current		read design documentation, working drawings, electrical diagrams, check the technical condition and residual life of the equipment; **Possession skills:** analysis of technical and technological documentation for EP; application of calculations in the design of electrical machines and transformers; identification of rational areas of application of various motors and control systems for electromechanical converters, taking into account the requirements of the technological process.
22	Special competencies	Relay protection and automation	7	**To know:** the causes of abnormal modes of the power system and ways of their automatic detection and prompt 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 installations 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, monitoring and verification of relay protection devices; **Possession skills:** check the protection and installation of panel linings, cabinets and terminals using modern tools for inspection and repair
		Relay protection of electrical equipment		**To know:** principles of automatic control of electrical installations and electrical networks using relay protection and automation devices, - types of damage and abnormal operating modes in electrical installations and electrical networks, the causes of their occurrence and ways to prevent accidents in electrical installations; **Be able to:** choose the types of relays and other devices of various types of RS; - work with regulatory documents, instructions for the device and operation of RS facilities, reference literature and other information sources **Possession skills:** checks for damage and abnormal operating modes of electrical installations and electrical networks.
23	Special competencies	Overvoltage and isolation in power supply systems	7	**To 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. **Possession skills:** choose EC protection against overvoltage in matters of protection from power lines and substations.
		Isolation and overvoltage in electric power systems		**To know:** laws of electrical engineering; basic power elements of electrical systems; electrical materials; **Be able to:** analyze wave equations and equations describing the behavior of charged particles in electric and magnetic fields; **Possession skills:** skills of practical measurement of currents and voltages in simple circuits.

24	Special competencies	Design of power stations and substations	7	**To know:** the content and features of the design of power plants; the basic principles of the choice of thermal 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 system design management. **Be able to:** work with the initial data when designing; 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 stations, switchgear circuits and circuits of own needs of power stations; select electric motors for working mechanisms and check them according to the conditions of start-up and self-start. **Possession skills:** practical application of the acquired knowledge; use of methods of analysis of power supply systems; application of modern computational design tools; application of graphical programs for the creation of design and technical documentation.
		Design of power supply systems		**To know:** the main regulatory and technical documents adopted for management in the territory of the Republic of Kazakhstan; the main stages and sequence of design of 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. **Possession skills:** practical application of the acquired knowledge; use of methods of analysis of power supply systems; application of modern computational design tools; application of graphical programs for the creation of design and technical documentation.
25	Special competencies	Safety and operating rules	8	**To 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 procedures 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;
		Labor protection		**To know:** the regulatory framework of labor protection; - the procedure for ensuring and organizing labor protection in the field of professional activity; - working conditions and the impact of negative

		in the electric power industry		factors of the production environment on the human body; **Be able to:** identify negative factors in production; - apply methods and means of protection against their effects; - to provide conditions for the safe operation of all types of production equipment; **Possess: skills:** first aid skills ; first aid to the victim.
				To know: the main regulatory and technical documents adopted for management in the territory of the Republic of Kazakhstan; the main stages and sequence of design of 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. **Possession skills:** practical application of the acquired knowledge; use of methods of analysis of power supply systems; application of modern computational design tools; application of graphical programs for the creation of design and technical documentation.
26	Special competencies	Power converter devices	8	**To know:** device and principle of operation of modern power semiconductor elements; device and principle of operation of semiconductor converters used in electric drive; physical phenomena occurring in semiconductor converters; basic 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 microprocessor control systems; programming tools for modern microcontrollers. **Be able to:** calculate and select the main elements of the circuits of power converting devices; make a preliminary calculation of the parameters and 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. **Possession 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.
		Energy saving and quality of electrical energy		**To 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. **Possession skills:** To 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	History of Kazakhstan	General education	To know: - demonstrate knowledge and understanding of the main stages of the development of the history of Kazakhstan; Be able to: - to correlate the phenomena and events of the historical past with the general paradigm of the world-historical development of human society through critical analysis; - be able to objectively and comprehensively comprehend the immanent features of the modern Kazakh model of development; Own: - possess the skills of analytical and axiological analysis in the study of historical processes and phenomena of modern Kazakhstan; - to systematize and give a critical assessment of historical phenomena and processes of the history of Kazakhstan
1	Foreign language	General education	To know: - lexical minimum and language material of topics and subtopics in this discipline (social and household and socio-cultural spheres of communication). Be able to: - understand by ear not only individual phrases and frequently used words, but also more voluminous statements on topics directly related to him, - understand the main content of short simple messages on the radio, at the airport, at the train station. - understand when reading the content of short, simple texts, advertisements, brochures, menus, bus and train schedules, a short, simple personal letter, an electronic message. - communicate in simple typical situations that require the exchange of information within the framework of familiar topics and activities, be able to talk about family, living conditions, educational classes. - write a simple personal letter, a note, an autobiography. Own: -understanding of foreign-language dialogic and monologue speech within the framework of general cultural and professional topics; - a foreign language at a level that allows you to carry out the main types of speech activity;

			- various ways of oral and written communication; - skills of adequate response in situations of everyday, academic and professional communication; - listening, reading, writing skills.
1	Kazakh (Russian) language	General education	To know: - theoretical foundations of the course (language, its functions, forms of speech, text, its features, speech styles, functional and semantic types of speech); - features of dialogic and monologue speech; - types of scientific information and specifics of its implementation in a scientific text; - elements of structural and semantic analysis and semantic analysis of a scientific text, components of the speech situation, the speaker's intentions. Be able to: - to make the right choice and use of language and speech means to solve certain problems of communication and cognition on the basis of knowledge of a sufficient volume of vocabulary, a system of grammatical knowledge, pragmatic means of expressing intentions; - to compose everyday, socio-cultural, official and business texts in accordance with generally accepted norms, functional orientation, using lexical, grammatical and pragmatic material of a certain certification level that is adequate for the set goal; - to convey the factual content of texts, formulate their conceptual information, describe the deductive knowledge (pragmatic focus) of both the entire text and its individual structural elements; - interpret the information of the text, explain the stylistic and genre specifics of the texts of socio-cultural, socio-political, official-business and professional spheres of communication in the scope of certification requirements; - participate in communication in various situations of different spheres of communication in order to realize their own intentions and needs (domestic, educational, social, cultural), stating them ethically correctly, meaningfully fully, lexically-grammatically and pragmatically adequate to the situation; - discuss ethical, cultural, socially significant issues in discussions, express your point of view, defend it with reasoned arguments, critically evaluate the opinion of interlocutors; - to build programs of speech behavior in situations of personal, social and professional communication in accordance with the norms of language, culture, specifics of the sphere of communication, certification requirements; - request and report information in accordance with the communication situation, evaluate the actions and actions of participants, use information as a tool to influence the interlocutor

			in situations of cognition and communication in accordance with certification requirements. Own: - the skills of producing oral and written speech in accordance with the communicative purpose and professional sphere of communication; - language skills in various situations of everyday, socio-cultural, professional communication; - skills of searching, processing information in Russian; - types of speech activity.
1	Information and communication technologies	General education	To know: - what economic and political factors contributed to 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; design and create simple websites; - process vector and raster create multimedia presentations; use various platforms for communication; - calculate and evaluate performance indicators of supercomputers; - use various forms of e-learning to expand professional knowledge; - use various cloud services. Possess : Possession skills: - database structure development; - designing and creating presentations; - receiving data from the server; - creating video files; - work with Smart applications; - work with services on the e-government website.
2	Philosophy	General education	To know: - basic philosophical concepts and categories, patterns of development of nature, society and thinking; - the essence of philosophical categories, terminology of philosophy and the structure of philosophical knowledge, functions of philosophy methods of philosophical research; - the place and role of philosophy in public life; Be able to: - to use the basics of philosophical knowledge to form a worldview position; - analyze philosophical problems of worldview, social and personal significance; - to orient oneself in the system of philosophical knowledge as a holistic view of the foundations of the universe and the prospects for the development of planetary society; - to understand the characteristic features of the modern stage of philosophy development Own: - skills of philosophical analysis of various types of worldview;

			- the skills of philosophical thinking to develop a systematic, holistic view of the problems of society; - skills of analyzing texts with philosophical content
1	Sociology	General education	To know: - patterns and stages of the historical process, the main historical facts, dates, events and names of world and domestic historical figures; - the main events and processes of national history in the context of world history Be able to: - critically perceive, analyze and evaluate historical information, factors and mechanisms of historical changes; - analyze civil and ideological positions in society, form and improve their views and beliefs, transfer philosophical worldview to the field of material and practical activities; - use various philosophical methods to analyze trends in the development of modern society, philosophical and legal analysis Own: - skills of a holistic approach to the analysis of society's problems; - methods of philosophical, historical and cultural studies, techniques and methods of analyzing the problems of society; - causal relationships in the development of Kazakhstan society; the place of a person in the historical process and the political organization of society; the skills of respectful and careful attitude to the historical heritage
1	Political Science	General education	To know: - the main stages of the development of political knowledge in the history of civilization; - schools and directions of modern political science; - political life of society; - the political system and its institutions; - the essence of political processes in the country and the world. Be able to: - analyze the features of political systems and the functioning of political institutions; - critically evaluate the theoretical approaches of political science; - to identify the interrelationships and patterns of the political process; - compare political systems, institutions and actors in an inter-country and subnational context, based on the knowledge gained and the methods mastered. Own: - Have the skills (gain experience) of working with primary sources on the topics of the

			course; analysis of regulatory legal acts and other documents; search, processing and analysis of information; solving problems related to the assessment of the political course; working in groups, project activities, business games; public speaking; academic writing. Have the skills to express their thoughts and opinions in interpersonal and business communication in a foreign language; the skills to extract the necessary information from the original text in a foreign language.
1	Cultural studies	General education	To know: - basic theories of culture, basic concepts of cultural studies; the main directions of the methodology of modern cultural analysis; - the history of the formation of world culture and civilization, theoretical features of basic cultural concepts, various interpretations of culture and civilization in world and domestic literature; - actual problems of the development of modern culture; - the idea of culture as a socio-historical phenomenon; - patterns of the development of world cultures, as well as the typology of the classification of cultures; -basic knowledge about the history of the most important cultures of mankind; - about the ways of acquiring, storing and transmitting the basic values of culture - about the diversity and self-worth of various cultures, - forms and types of culture, patterns of their functioning and development, the main cultural and historical regions - the history of Kazakh culture, its place in the system of world culture and civilization Be able to: - be able to identify the features of this culture, the dominant values in it; - explain the specifics of intercultural communication; - be able to conduct independent professional activity in a dynamically changing multicultural society; - be able to navigate the cultural environment of modern society; - be able to explain the phenomenon of culture, its role in human life; - be able to navigate cultural issues, independently understand the issues of the influence of cultural factors on the behavior of individuals; - Own: - practical skills in the preservation and enhancement of national and world cultural heritage; - practical skills of practical use of knowledge and skills in taking into account the specifics of cultural behavior of various individuals and collectives in the modern conditions of the

			formation of civil society in the Republic of Kazakhstan.
1	Psychology	General education	To know: the meaning and place of psychology in the system of sciences; the main directions of personality development in modern psychology; personal values and meanings in professional self-determination; the relationship and mutual influence of the psyche and body; techniques and techniques of effective communication. Be able to: interpret basic psychological theories, concepts; use methods and mechanisms of emotion regulation in everyday life; identify patterns of behavior in a conflict situation and conduct self-diagnosis. Own: definitions of individual psychological characteristics of personality, value-semantic representations in professional self-determination of personality; recognition of psychological impact and effective communication.
1	Fundamentals of economic and legal knowledge	General education	To know: methods of scientific research in economics, various theories about entrepreneurship, financial literacy and market economy, types of entrepreneurial activity, entrepreneurship, to learn various quantitative and qualitative methods for creating the future of their own business, entrepreneurial calculations, analytical calculations and forecasts, the main provisions of the Constitution and current legislation of the Republic of Kazakhstan, the system of public administration and the circle their powers, the mechanism of interaction of substantive and procedural law, the essence of corruption and the causes of its origin, the current legislation in the field of anti-corruption. Be able to: analysis and justification of the reality of business plans, Market Segmentation, competent and professional assessment of the market situation for organizing their own business, a creative approach to solving various economic tasks, possession of practical skills in independently carrying out economic work in the field of entrepreneurship, calculation of a personal budget, possession of accurate initial information and quick and correct orientation to economic indicators, analysis of, be guided by the current legislation, applying the law on the application of spiritual and moral mechanisms for the Prevention of corruption. Own: possess the practical skills of constructing graphs and schemes reflecting various economic models, independently carry out economic work in the field of entrepreneurship, quickly and correctly orientate specific initial information and reporting economic indicators, determine the levels of financial security, identify problems of an economic nature when analyzing specific situations and solve them. conduct discussions on legal issues at the micro- and macro levels, on the issues of applying norms at the present stage, analyze the situation with conflicts of interest and moral choice.

1	Fundamentals of scientific and environmental knowledge	General education	To know: forms and methods of pre-scientific, scientific and extra-scientific cognition, modern approaches to socio-humanitarian knowledge and their commensurability; basic epistemological models, the nature of transformations of the concept of rationality; fundamentals of ecology and safe human activity in the habitat, environmental factors and their impact on living organisms, methods for identifying, eliminating the influence of harmful factors on humans and the environment, and providing comfortable conditions for human life and activity; Be able to: formulate and solve problems that arise in the course of research and require in-depth professional knowledge; modify existing and develop new methods based on the objectives of a specific study; choose methods of protection from hazards in relation to the field of their professional activities and choose ways to ensure comfortable living conditions; Possession skills: skills of conducting independent research and scientific and pedagogical activities that require extensive education in the appropriate direction; the ability to apply methodological and methodological knowledge in conducting scientific research; skills to ensure the safety of life in professional activities, living conditions and in emergency situations.
1	Mathematics I	Professional competencies	To 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 by mathematical methods, as well as the use of known methods to solve formulated problems; Possession skills: independent or based on educational training programs for advanced training in the field of mathematical knowledge in order to meet modern requirements of the specialty
1	Mathematics II	Professional competencies	To 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 integration of 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;

			Possession skills: solving engineering problems using mathematical methods;
1	Physics	Professional competencies	To 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 and situations; 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 observations obtained and data measurement. Possession skills: the ability to work with measuring instruments, devices; - perform statistical processing of observation and measurement results and perform graphical representation.
3	Professional Kazakh (Russian) language	Professional competencies	To know: - professional vocabulary and terminology; - the specifics of oral communication in the professional sphere; - language features of oral and written communication; - features of business communication and business etiquette. Be able to: - use the Russian language in interpersonal communication and professional activities; - to carry out business communication and conduct business conversations on professional topics; - to formalize and transmit the necessary information in writing; - explain your point of view and critically evaluate the proposed provisions; - create your own statements, essays, etc. - apply the norms of business etiquette in speech Own: - skills of expressing their thoughts and opinions in interpersonal and business communication in Russian; - professional terms and concepts; - professional text analysis; - information competence: the ability to work with a book, textbook, reference literature, dictionaries, to find the necessary information.
3	Professionally-oriented foreign language	Professional competencies	To know: - lexical material on the topics of this discipline; - regulatory requirements for registration (official letter, essay, etc.).

			- improve pronunciation skills; - develop productive and receptive lexical and grammatical skills; - to improve the skills of dialogical speech of a general nature related to situations of everyday and professional communication; - develop listening skills (with full understanding of what you have heard); - develop and improve writing skills; - improve the skills of introductory, studying, viewing and searching reading. Be able to: - automate technical skills of reading about yourself; develop the ability to transmit scientific information and literature of a socio-political nature; - develop skills of monologue (prepared) speech – thesis deployment; - master the reversed reading aloud of a prepared message; - teach referencing skills. Own: - complexity in solving practical, educational, educational and developmental goals (with practical goals acting as the leading ones); the communicative orientation of the learning process.
2	General energy	Professional competencies	To 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 electric grid lines; the purpose and element base of relay protection; the composition of consumers in various industries; the principles of building external and internal power supply circuits; voltage modes in industrial networks. 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. Possession skills: in the calculation of modern energy conservation technologies.
	World energy		To 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. Possession skills: in the calculation of modern energy conservation technologies.
2	Descriptive geometry and engineering graphics using computer	Professional competencies	To know: building drawings; projection methods; Monge plots; methods of converting orthogonal projections; positional and metric tasks; axonometric projections; general rules for drawing; reading and detailing assembly drawings. The basics of computer graphics

	technology		programs. Three-dimensional modeling. 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 the assembly unit; read drawings of assembly units; Possession 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;
	Basics of computer drawing		To know: an idea of computer drawing systems by example to teach how to run a program, introduce its window and the main toolbars. modern CAD development trends; interface, main system panels, parameter string, technical requirements for PC configuration when installing various CAD systems; types of design documents; CAD application areas; requirements for the drawing frame; Be able to: solve problems of computer drawing systems using the example of the COMPASS program. configuring the CAD interface; editing the CAD menu and toolbar; creating the simplest geometric shapes; using local and global bindings; Possession skills: skills of working with graphic editors; to separate the types of mechanical engineering products and design documents for these products, as well as the rules for sizing; • effective performance of tasks in CAD; experience in using CAD and graphic editors to solve drawing and graphic problems by means of two-dimensional graphics;
2	Metrology and standardization	Professional competencies	To know: 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; 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; Possession 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.

	Fundamentals of metrology		To 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; basic methods and means of measurement; legislative and regulatory legal acts, methodological materials on standardization, metrology and quality management Be able to: analyze measurement schemes of various physical quantities, determine measurement errors and creatively apply knowledge in the learning process; skills to assess the accuracy of the obtained measurement results; carry out normalization control of technical documentation; set a task, build an algorithm for its implementation, practically perform measurement operations; evaluate the reliability of the results obtained Possession skills: work with control and measuring equipment for control; determination of metrological security of production; use of reference literature; use quality indicators, statistical methods of quality management in construction; methods of processing measurement results; methods of checking the normality of the distribution of random errors

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	The module of historical and philosophical knowledge	History of Kazakhstan	RC GED	2	5	SE	10
		Philosophy	RC GED	4	5	Exam	
M.2	Instrumental and communication module	Foreign language	RC GED	1,2	10	Exam	25
		Kazakh (Russian) language	RC GED	1,2	10	Exam	
M.3	Economics and Ecology Module	Fundamentals of economic and legal knowledge	GES/UC	2	3	Exam	5
		Fundamentals of scientific and environmental knowledge	GES/UC	2	2	Exam	
M.4	Socio-political knowledge module	Sociology	RC GED	2	2	Exam	8
		Political Science	RC GED	2	2	Exam	
		Cultural studies	RC GED	1	2	Exam	
		Psychology	RC GED	1	2	Exam	
M.5	Health promotion module	Physical Culture	RC GED	1-4	8	Dif.offset	8
M.6	Mathematics	Mathematics I	UK BD	1	4	Exam	7
		Mathematics II	UK BD	2	3	Exam	
M.7	Physical processes and electronics in the electric power industry	Physics	UK BD	1	5	Exam	16
		Educational practice	UK BD	2	1	Dif.offset	
		Theoretical foundations of electrical engineering I	UK BD	3	5	Exam	
		Theoretical foundations of electrical engineering II	UK BD	4	5	Exam	
M.8	Professional communicative	Professional Kazakh (Russian) language	UK BD	5	3	Exam	6
		Professionally-oriented foreign language	UK BD	5	3	Exam	
M.9	Energy	General Energy / World Energy	CC BD	3	3	Exam	8
		Alternative and renewable energy sources/ Unconventional energy	CC BD	5	5	Exam	
M.10	Graphics and standardization	Descriptive geometry and engineering graphics using computer technology Fundamentals of Computer Drawing	CC BD	3	5	Exam	20
		Metrology and Standardization / Fundamentals of Metrology	CC BD	3	5	Exam	
		Electrical measurements in electrical installations / Measurement of electrical and non-electrical quantities	CC BD	4	4	Exam	
		Industrial practice I	CC BD	4	2	Dif.offset	
		Electrical drawings and diagrams / Drawing and designing of electrical circuits	CC BD	4	4	Exam	

M.11	Electric machines and electric drive	Basics of electric drive / Adjustable electric drive in the electric power industry	CC BD	3	5	Exam	10
		Electric machines	CC BD	4	5	Exam	
M.12	Safety in electrical appliances	Rules of technical safety and operation / Labor protection in the electric power industry	CC BD	8	4	Exam	4
M.13	Electrical devices and relay protection	Switching of electrical devices / Electrical and electronic devices	CC BD	5	5	Exam	11
		Relay protection and automation / Relay protection of electrical equipment	CC BD	7	6	Exam	
M.14	Transients in the electric power industry	Electrical Materials science / Materials in the electric power industry	CC BD	4	3	Exam	17
		Electromagnetic compatibility in the electric power industry / Electromagnetic compatibility of technical means	CC BD	7	5	Exam	
		Transients in the electric power industry / Electromagnetic and electromechanical processes	CC BD	5	4	Exam	
		Overvoltage and isolation in power supply systems / Isolation and overvoltage in electric power systems	CC BD	7	5	Exam	
M.15	Power converter devices	Power converter devices / Energy saving and quality of electrical energy	CC PD	8	6	Exam	18
		Industrial practice III	UK PD	8	10	Exam	
		Pre-graduate practice	UK PD	8	2	Exam	
M.16	Entrepreneurship	Fundamentals of entrepreneurship in the electric power industry / Organization and planning of energy enterprises	CC PD	6	4	Exam	4
M.17	Installation, repair and operation of electrical equipment	Installation and operation of electrical equipment of power plants	CC PD	5	5	Exam	13
		Electrical equipment / Electromechanics and electrical equipment	CC PD	6	4	Exam	
		Industrial practice II	UK PD	6	4	Dif.offset	
M.18	Electric stations and substations	Electrical stations and substations / Electrical equipment of stations and substations	CC PD	6	5	Exam	15
		Design of power stations and substations / Design of power supply systems	CC PD	7	5	Exam	
		Transmission and distribution of electricity / Transmission of electricity by direct and alternating current	CC PD	7	5	Exam	
M.19	Power supply and lighting	Power supply / Power supply of electric power facilities	CC PD	6	7	Exam	16
		Fundamentals of Electric lighting / Lighting equipment and lighting	CC PD	7	4	Exam	
		Electrical Systems and Networks / Electric Power Industry	CC PD	5	5	Exam	
M.20	Electronics and automation	Basics of Electronics	CC PD	3	5	Exam	11
		Automation of electric power facilities / Fundamentals of automatic control	CC PD	6	6	Exam	
M.21	Final certification	Final certification	DVO	8	8	FC	8