

Ministry of agriculture of the Republic of Kazakhstan  
S. Seifullin Kazakh agrotechnical University

DISCUSSED  
at session  
Academic Council of the University

Protocol № 15  
from "30" "05" 2019

Approved by  
President  
JSC "S. Seifullin Kazakh  
agrotechnical University."  
A. K. Kurishbayev  
2019



**EDUCATIONAL PROGRAM**

**6B07108 "Automation and energy efficiency of processes and productions»**  
(program name)

Education area code and classification

6B07 Engineering, manufacturing and construction industries

Code and classification of training areas  
The International standard classification of education code

6B071 Engineering and engineering 0710

Degree awarded

bachelor of engineering and technology

Period of study

4 years

Form of training

intramural

Language of instruction

state / Russian

Nur Sultan 2019

Group of authors:

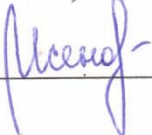
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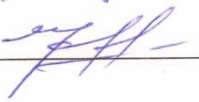
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The author's team was approved by the order of JSC "KATU.S. Seifullina" No. 932-N of 12.12.2018

The educational program "automation and energy efficiency of processes and productions" was considered at the meeting of the Department of electrical equipment operation (Protocol No. 10 of 08.04.2019) and approved by the Academic Council of the faculty of energy (Protocol No. 12 of 24.04.2019).

Dean of the faculty of energy  Isenov S. S.

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## Content of the educational program

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## **1. Passport of the educational program**

### **1.1 Purpose of the educational program:**

Creation of conditions for effective educational process for the formation and development of personal, socio-cultural, General engineering and professional competencies in the field of automation, management and energy efficiency of processes and industries.

### **1.2 Learning Outcomes**

1 To formulate the purpose and objectives of the work, analyze and determine ways to solve problems in professional activities, organize effective and stress-resistant work performed individually or collectively, using communication skills in Kazakh, Russian and foreign languages.

2 To Use the basic provisions and methods of social and economic Sciences in solving personal and professional problems.

3 To Use information and communication technologies and modern software products to solve personal and professional problems.

4 To solve professional problems based on the laws of natural Sciences, methods of mathematical analysis and modeling, theoretical and experimental research.

5 To analyze the work environment and organize the protection of personnel and the population from production factors, possible consequences of accidents, catastrophes, natural disasters.

6 to Develop projects in the professional sphere and their elements in accordance with the terms of reference and regulatory and technical documentation, as well as to justify design decisions and present the results of the work.

7 to carry out installation, adjustment and repair of objects of professional activity, to keep necessary documentation, and also to use normative-legal documents at carrying out these works.

8 to Evaluate the operating modes of equipment and complexes, to determine the most rational parameters, to form conditions for their maintenance, to manage the quality and reliability of the functioning of power supply and automation systems, to offer modern effective technologies and tools.

9 to Plan and carry out maintenance and operation of objects of professional activity, to diagnose a condition of the equipment on the basis of measurements and tests, on results to formulate conclusions and recommendations, to conduct the corresponding documentation.

## **2. General characteristics of the educational program (relevance, features, competitive advantages, uniqueness, etc.)**

### **2.1 Relevance**

Automation of technological processes and production characterizes the level of production and technical progress of industry, transport, agriculture, etc. currently and in the future, industry, economy, education will be subject to large-scale and widespread introduction of digitalization, the basis of which is the automation of technological processes and production. The main goal is to increase productivity, safety, environmental friendliness and efficiency, improve the quality of products and services, improve the reliability and accuracy of production.

In addition, resource conservation and energy efficiency are one of the strategic objectives of any state of the XXI century. The efficiency of industry, transport and agriculture largely depends on the energy costs of their work, so new and existing facilities that need thermal and electric energy should introduce modern and promising methods and technologies, use new equipment and equipment. In order to reduce the negative impact of traditional energy and improve the environmental situation, Kazakhstan actively uses renewable energy sources, which corresponds to the priorities of the state.

The creation of a complex of software and hardware for the management of various processes within the technology, production, enterprise requires the training of high-level specialists and knowledge on a wide range of issues. Of course, to solve such problems of a particular technological process or production, specialists are needed who will carry out system analysis, create and implement complex projects on automation, increase energy efficiency and energy saving, and develop "green" energy. This educational program is aimed at creating conditions for the training of such specialists.

### **2.2 Competitive advantages**

- This educational program covers the training profiles "Energy saving and renewable energy sources", "Energy management and audit", "Automation of technological processes", one of which the student chooses according to his preferences.

- \* Training of specialists of electric power profile at University is conducted more than 50 years. The profile of training specialists in automation begins its history with the opening of the specialty "electrification and automation of agriculture".

- \* Experienced scientists and teachers train future specialists, preserving and developing rich traditions in the Department and faculty.

- \* Training profiles "Energy saving and renewable energy sources", "Energy management and audit" were developed with the support of the international projects of the European Union Tempus "development of the bachelor's degree program "Energy management" and "Implementation of the quality management system of e-learning in Central Asian Universities".

- All relevant disciplines are provided with modern laboratory facilities (Siemens, Schneider Electric, Danfoss, Festo, Edibon, Arduino, Educational equipment, etc.),

there is a research and training ground for wind and solar energy, a training center for energy conservation and energy audit, a specialized laboratory of renewable energy sources.

\* Full multimedia equipment for all classrooms with audio and video recording to control the quality of the educational process and ensure the safety of students.

\* Full provision of educational and methodical materials in the state and Russian languages for classroom and independent work.

\* Stable base of practices and employment, close relationship with potential employers and their participation in the development of curricula, programs of special disciplines.

\* Profiles of the preparation of this educational program are annually evaluated by independent organizations: according to the evaluation of the National chamber of entrepreneurs "Atameken" took 2nd place, according to the National Agency for accreditation and rating the program in 2017 took 1st place, in 2018-3rd place, according to the National rating for innovation and academic excellence "Kazakhstan 2050" in 2017-2nd place, according to the Independent Kazakhstan Agency for quality assurance in education in 2016 - 2nd place

#### **2.4 The Potential of the profession (office)**

- Engineer of instrumentation and automation.
- Engineer for automation and mechanization of production processes.
- Engineer for automated process control systems.
- Programmer-developer.
- Circuit engineer.
- Design engineer.
- Engineer-designer.
- Electrical engineer.
- Power engineer.
- Test and commissioning engineer.
- Operations engineer.
- Engineer for calculations and modes.
- Senior dispatcher.
- Master of the production site.
- Head of the laboratory.
- Shift supervisor.
- Chief of service.
- Section

foreman

### **3. Competence model (portrait) of the graduate**

#### **3.1 Areas of professional activity**

- \* Automation of hydrodynamic processes: washing, separation, mixing.
- \* Automation of thermal processes: heating and cooling.
- \* Automation of mechanical processes: transportation, moving, sorting, cleaning, grinding, cutting, dosing, etc.
- \* Automation of electrical processes: lighting, irradiation, electrical technology, power supply.
- \* Control of pump, compressor and fan installations.
- \* Control of numerical control machines, industrial robots and manipulators.
- \* Algorithms, regulation and control systems, data transmission and storage systems.
- \* Microprocessors and microcontrollers.
- \* Control and measurement systems.
- \* Production, transmission and distribution of heat and electricity.
- \* Energy saving and management of energy resources consumption at the enterprise.
- \* Energy management and audit of the enterprise.
- \* Energy efficiency of processes and productions.
- \* Energy saving programs and their implementation.
- \* Wind, solar, bio and hydro power plants.
- \* Use of renewable sources, their energy and economic efficiency.
- \* Lighting and light sources.

#### **3.2 Professional activities**

Bachelor of the educational program "automation and energy efficiency of processes and production" can carry out the following types of professional activities:

- \* design - design of automated control systems of technological processes; design of installations and systems of power supply of enterprises and settlements;
- \* production and technological-analysis of technological processes and productions, improvement of quality and speed of automation systems, introduction and adaptation of modern automation systems of existing productions; assessment and organization of effective use of energy resources at various technological processes, introduction and adaptation of modern energy saving technologies for effective modes of operation of the main electrotechnical and technological equipment;
- \* organizational and management - organization, control and management of all stages of functioning of automation systems, including the work of personnel; organization, control and management of operating modes of power supply systems and process equipment;
- \* research - carrying out experimental and development works in automation systems and power supply of processes and productions;
- \* installation and adjustment - installation, adjustment, operation and repair of automation devices, measurement systems of technological and power complexes,

electrical and thermal equipment of systems of transmission and distribution of thermal and electric energy;

\* service and operational - maintenance, maintenance and overhaul of electrical equipment, power plants, automation and communication, control and measuring devices.

### **3.3 General education competences**

**Understand the main stages of the history of progressive development of Kazakhstan's statehood in the context of the world and Eurasian processes.**

\* To Have the skills to use ICT for information retrieval and processing.

\* To have communication skills in Kazakh / Russian and foreign languages.

\* To Have an open mind, understand their own national code and national identity, spiritual modernization, competitiveness, realism and pragmatism, independent critical thinking, the cult of knowledge and education.

\* To use key ideological concepts such as justice, dignity and freedom, as well as to develop and strengthen the values of tolerance, intercultural dialogue and a culture of peace.

\* To Express and argue for their own opinion on issues of social importance.

\* To Analyze the features of social, political, cultural, psychological institutions in the context of their role in the modernization of Kazakhstan's society.

\* To Possess basic economic and legal knowledge and carry out business activities.

\* To Possess the personal, intercultural and civic competences.

\* To Have a sufficient level of physical readiness of future specialists, a high level of performance, the development of professionally significant physical and psychomotor abilities.

### **3.4 Core competencies**

\* To put into practice the rules of safety, industrial sanitation, fire safety and labor protection.

\* To apply in practice methods of testing of technological, electric equipment and objects of automation and control.

\* To calculate operating modes of typical technological and power plants.

\* To check the technical condition, organize inspections and maintenance of equipment.

\* To apply fundamental knowledge to specific design and operation tasks.

\* To develop project options and carry out their technical and economic comparison.

\* To Use the necessary literature in the design and operation of equipment.

\* To be prepared to change social, economic, professional roles, geographical and social mobility.

\* Make economic and organizational decisions in the face of uncertainty and risk.

### **3.5 Professional competence**

\* To carry out calculations of operating modes of technological and power equipment.



- \* To Develop projects of power plants, power plants and energy complexes based on NVE.
- \* To Design of automatic control system of technological processes.
- \* To test and diagnose the condition of devices and equipment of automation systems, main power and auxiliary equipment.
- \* To carry out installation and adjustment of devices and the equipment of systems of automation and power supply.
- \* To repair electrical equipment, control and measuring instruments and devices.
- \* To Implement modern control, management and digitalization systems in existing and projected technological processes and productions.
- \* To conduct energy consumption analysis, taking into account the assessment of savings measures;
- \* To conduct energy audits.
- \* To plan and organize the energy management system at the enterprise with the assessment of their effectiveness.

#### **4 Base of passing of professional practices**

Akmola grid distribution company, Astana - regional power grid company, Kyzylorda distribution grid company, Astana electrotechnical plant, Mangystau branch of the main network, "Rodina"Agrofirm, Baiserke-agro, Kaznii of mechanization and electrification of agriculture, AST – Technology, Astana kalalyk Zharyk, New systems - teplolyux, IP-Stroyenergomagistral, Energy service RTD, Energy Consulting Group, Iaim Group Astana, General Director KZ plan, Astana construction engineering Corporation

## 5 structure of the educational program

№	Name of complexy and disciplines	Total labor intensity	
		in academic hours	in academic credits
1	The complex of General educational disciplines (OOD)	1680	56
1)	Required component	1530	51
	Modern history of Kazakhstan	150	5
	Philosophy	150	5
	Foreign language	300	10
	Kazakh (Russian) language	300	10
	Information and communication technologies (in English)	150	5
	Political science and sociology	120	4
	Cultural studies and psychology	120	4
	Physical culture	240	8
2)	High school component	150	5
	Fundamentals of Economics and law	150	5
	Ecology and BDZ	150	5
2	Complex of basic disciplines (DB)	5160	172
1)	High school component	1560	52
	Math 1	150	5
	Physics	150	5
	Theoretical foundations of electrical engineering 1	240	8
	Electrical measurement	150	5
	Electrical materials science	120	4
	Theoretical foundations of heat engineering	150	5
	Digital and microprocessor technology	180	6
	Safety in power plants	150	5
	Educational practice	30	1
	Manufacturing practice	240	8
2)	Optional component	3600	120
	Automated electric drive	240	8
	Fundamentals of mechatronics	240	8
	Engineering graphics	90	3
	Electrical drawings	90	3
	Theoretical mechanics	120	4
	Applied mechanics	120	4
	Math 2	150	5
	Applied problems of mathematics	150	5

№	Name of complexy and disciplines	Total labor intensity	
		in academic hours	in academic credits
	Leadership and organization	150	5
	Theoretical foundations of electrical engineering 2	150	5
	Technology of installation of electrical equipment and electrical installations	150	5
	Automation elements and devices	150	5
	Instrumental energy audit	180	6
	Linear automatic control systems	180	6
	Electric lighting and irradiation	180	6
	Typical production mechanisms	180	6
	Energy management and audit	150	5
	Nonlinear automatic control systems	150	5
	Energy saving by industry	240	8
	Automation and control systems of technological processes	240	8
	Economy and organization of production	150	5
	Investment management	150	5
3	Complex of profile disciplines (PD)	2160	72
1)	University component and (or) optional Component	1440	48
	Electric machine	240	8
	Heat networks and heat supply systems	180	6
	Electrosupply	180	6
	Operation and repair of electrical equipment	180	6
	Production management	120	4
	Manufacturing practice	300	10
	Design work	240	8
2)	Optional component	720	24
	Wind energy	180	6
	Solar power	180	6
	Industrial controller	180	6
	Electrotechnology	180	6
4	Additional types of training (DVO)	-	-
5	Final certification	360	12
1)	Writing and defending a thesis (project) or preparing and passing a comprehensive exam	360	12
	Subtotal	9360	312

# Annex 1. Academic calendar

Министерство сельского хозяйства Республики Казахстан  
Казахский агротехнический университет им. С.Сейфуллина

Рассмотрено на заседании  
Ученого совета университета  
Протокол № \_\_\_\_\_ от \_\_\_\_\_  
" \_\_\_\_\_ " \_\_\_\_\_ 2019 г.

УТВЕРЖДАЮ  
Директор департамента по академическим вопросам  
АО "КАТУ им.С.Сейфуллина" \_\_\_\_\_  
" \_\_\_\_\_ " \_\_\_\_\_ 2019 г. Н.А.Серекпаев

Академический календарь на 2019-2020 учебный год

Образовательные программы: "Энергообеспечение и автоматизация сельского хозяйства", "Автоматизация и энергетическая эффективность процессов и производств"

Курсы	Сентябрь					Октябрь					Ноябрь					Декабрь					Январь					Февраль					Март					Апрель					Май					Июнь					Июль					Август				
	2020	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	2	9	16	23	30	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28		
№	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52								
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Презентация  Теоретич. обуч.  Экзамен. сессия  Каникулы  Производство практика  Летний сем.  Учеб. практик  Сдача отчета  Запись на дисп.  Сдача FX  Военные сборы

Праздничные дни

1 сентября  
16 - 17 декабря  
1-2 января  
30 августа

Международный женский день  
Праздник "Наурыз"  
День единства народов Казахстана  
День защитника Отечества  
День Победы

8 марта  
21-23 марта  
1 мая  
7 мая  
9 мая

Декан факультета \_\_\_\_\_ Исенов С. С. " \_\_\_\_\_ " \_\_\_\_\_ 2019 г.

Зав.кафедрой ЭЭО Сарсикеев Ж. Е. " \_\_\_\_\_ " \_\_\_\_\_ 2019 г.











### Annex 3. Description of University of an obligatory component disciplines

1. Basic information about the discipline:	
Name of discipline	Modern history of Kazakhstan
2. Prerequisites:	
3. Post-requisites:	
3. Post-requisites: Political science and sociology	
4. The content of the discipline	Attention is focused on the characteristics of history, the specifics of historical processes and phenomena. The course examines: the features and specifics of historical processes, the formation of the Patriotic spirit of students. The study of the specifics of the subject and methods of historical culture. The discipline is based on theoretical and methodological concepts. Priority is given to national ideas and movements.

1. Basic information about the discipline:	
Name of discipline	Philosophy
2. Prerequisites:	
3. Post-requisites:	
4. The content of the discipline	Formation of openness of consciousness, understanding of own national code and national consciousness, spiritual modernization, competitiveness, realism and pragmatism, independent critical thinking, cult of knowledge and education, on mastering of such key world Outlook concepts as justice, dignity and freedom, and also development and strengthening of values of tolerance, intercultural dialogue and culture of peace.

1. Basic information about the discipline:	
Name of discipline	Kazakh (Russian) language
2. Prerequisites:	
3. Post-requisites:	
4. The content of the discipline	Formation of social and humanitarian Outlook of students in the context of the national idea of spiritual modernization, involving the development on the basis of national consciousness and cultural code qualities of internationalism, tolerant attitude to world cultures and languages as translators of world-class knowledge, advanced modern technologies, the use and transfer of which are able to ensure the modernization of the country and personal career growth of future specialists.

1. Basic information about the discipline:	
Name of discipline	Information and communication technologies
2. Prerequisites:	
3. Post-requisites:	
4. The content of the discipline	Data analysis. Data management. Database system. Networks and telecommunications. Cybersecurity. Internet technology. Cloud and mobile technologies. Multimedia technologies. Smart technologies: the IoT, Big Data, the Block chain. Artificial intelligence. Green technologies in ICT. Teleconferences. E-technologies. E-business. E-learning. E-government. Information technology and professional sphere. Industrial ICT.

1. Basic information about the discipline:	
Name of discipline	Foreign language
2. Prerequisites:	
3. Post-requisites:	
4. The content of the discipline	The main purpose of the discipline "Foreign language" is the formation of communicative competence, i.e. the ability and willingness to carry out foreign language interpersonal and intercultural communication with native speakers.

1. Basic information about the discipline:	
Name of discipline	Political science and sociology
2. Prerequisites:	
3. Post-requisites: Philosophy	
4. The content of the discipline	The section "Sociology" is intended to form the ability of critical

	understanding of the system of interpersonal relations in society, awareness of the nature of society, the system of its groups and institutions. The section "political Science" forms knowledge about the laws and laws of world politics and modern political processes, explaining the essence and content of the policy of national States. Formation of social and humanitarian Outlook as the basis of modernization of public consciousness.
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1. Basic information about the discipline:	
Name of discipline	Cultural studies and psychology
2. Prerequisites:	
3. Post-requisites:	Philosophy
4. The content of the discipline	The section "cultural Studies" is aimed at the development of social and humanitarian Outlook, the ability to analyze and assess cultural situations, the specificity of cultural objects, the role of cultural values in intercultural communication. Fundamentals of General psychology, personality psychology, individual typological features of personality: temperament, character, abilities; Emotional and volitional sphere of personality, Cognitive processes: memory, attention, imagination, thinking and speech. Psychology of professional communication

1. Basic information about the discipline:	
Name of discipline	Physical culture
2. Prerequisites:	
3. Post-requisites:	
4. The content of the discipline	Discipline will help students to become a harmoniously developed personality, acquire knowledge in the field of physical culture, improve health. Ensuring a sufficient level of physical readiness of future specialists, a high level of performance, the development of professionally significant physical and psychomotor abilities, improving the sportsmanship of student-athletes.

1. Basic information about the discipline:	
Name of discipline	Fundamentals of Economics and law
2. Prerequisites:	
3. Post-requisites:	
4. The content of the discipline	Fundamentals of social production and forms of social economy. The mechanism of functioning of the market system. Production, costs and income of the firm. National economy. Economic growth and instability of the market economy . Inflation and unemployment are manifestations of economic instability. Fundamentals of the theory of state and law, constitutional law, administrative law, civil law, labor law, family law, criminal law.

1. Basic information about the discipline:	
Name of discipline	Ecology and BDZ
2. Prerequisites:	
3. Post-requisites:	Safety in power plants, Course and diploma design
4. The content of the discipline	Ecosystem and environmental factors. The biosphere and the modern noosphere. Global environmental problems of our time. Social and environmental problems of our time. Technosphere and industrial safety. Industrial and fire safety. Radiation and chemical safety. Emergencies of peace and war. Civil defense. Environmental safety as an aspect of life safety.

1. Basic information about the discipline:	
Name of discipline	Math 1

2. Prerequisites:	-
3. Post-requisites:	Theoretical foundations of electrical engineering
4. The content of the discipline	Elements of linear algebra and analytic geometry. Introduction to mathematical analysis. Differential calculus of functions of one variable. Functions of several variables. Integral calculus of functions of one variable. Ordinary differential equation

1. Basic information about the discipline:	
Name of discipline	Physics
2. Prerequisites:	
3. Post-requisites:	Theoretical foundations of electrical engineering, Electrical measurements
4. The content of the discipline	Physical foundations of mechanics. Statistical physics and thermodynamics. Electrodynamics. Physics of oscillations and waves. Wave and quantum optics. Elements of quantum physics. Physics of atomic nuclei

1. Basic information about the discipline:	
Name of discipline	Theoretical foundations of electrical engineering 1
2. Prerequisites:	Physics, Mathematics 1
3. Post-requisites:	
4. The content of the discipline	Basic concepts and definitions of the theory of electric circuits. 2 linear DC electrical circuits. Electrical circuits of single-phase sinusoidal current. Electrical circuits with mutual inductance. Three-phase circuits. Periodic non-sinusoidal currents. Nonlinear DC circuits. Two-port networks and electric filters

1. Basic information about the discipline:	
Name of discipline	Electrical measurement
2. Prerequisites:	Physics
3. Post-requisites:	
4. The content of the discipline	Modern Metrology. Measurement process. Measurement error. Processing and presentation of the measurement result. Measuring instruments for static measurements. Measuring instruments for dynamic measurements. Analog measurements of basic electrical quantities. Analog measurements of non-electrical quantities. Digital measurements: computer measurement methodology. Digital measurements of electrical quantities. Digital registration of measurements. Information and measuring systems and complexes. Measurement automation.

1. Basic information about the discipline:	
Name of discipline	Electrical materials science
2. Prerequisites:	Physics
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Basic information about the structure of matter. Classification of dielectrics. Characteristics of dielectrics. Breakdown of dielectrics. Dielectric strength. Conductor materials. Classification. Electrical conductivity of metals. Semiconductor material. Magnetic material.

1. Basic information about the discipline:	
Name of discipline	Theoretical foundations of heat engineering
2. Prerequisites:	Physics
3. Post-requisites:	Heat networks and heat supply systems, Electrotechnology
4. The content of the discipline	Basic concepts and definitions of thermodynamics. The first law of thermodynamics and its application to the analysis of polytropic processes. Cyclic process. The second law of thermodynamics. Thermodynamic analysis of thermal devices. Thermodynamics of gas flows. Phase transitions in thermodynamic systems. Mechanisms of heat transfer, thermal

	conductivity. Convective heat transfer. Heat exchange by radiation. Heat and mass transfer devices. Heat generating devices.
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1. Basic information about the discipline:	
Name of discipline	Digital and microprocessor technology
2. Prerequisites:	Physics, Mathematics 1
3. Post-requisites:	Automation and control systems of technological processes, automation Elements and devices
4. The content of the discipline	The basic basic sets of logical functions are: AND, OR, NOT, AND-NOT, OR-NOT. Circuitry of the main logic elements, their UGO. Characteristics of logic elements. Multiplexers. Decoders. Triggers.. Registers. Counters. Memory chips and their application. Digital automaton. Actions with numbers.

1. Basic information about the discipline:	
Name of discipline	Safety in power plants
2. Prerequisites:	Ecology and BDZ
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Legal and safety regulations. General issues of electrical safety. Electrical protective equipment. Protection against electric shock. Calculation of earthing devices in two-layer soil. Safety during electrical work. Safety during repair of electrical equipment. Safety during operation of electrical installations. Occupational hygiene and industrial sanitation. Fire safety

1. Basic information about the discipline:	
Name of discipline	Educational practice
2. Prerequisites:	-
3. Post-requisites:	-
4. The content of the discipline	Familiarization with the organizational structure of the University; familiarization with the organization of the educational process; tour of educational buildings and classrooms; familiarization with the functions and content of work in educational laboratory classrooms; familiarization with safety in classrooms; familiarization with regulatory and technical documentation, QMS for registration of student works; registration of the report on practice

1. Basic information about the discipline:	
Name of discipline	Manufacturing practice
2. Prerequisites:	Technology of installation of electrical equipment and electrical installations
3. Post-requisites:	Course and diploma design
4. The content of the discipline	The results of the tasks, paperwork. Safety instruction (General). Safety training and workplace instruction. Familiarization with the enterprise and its power supply and automation system. Performance of production tasks. The study of theoretical material. Independent work with literature and technical documentation. Collection, processing, systematization and analysis of factual and literary materials.

1. Basic information about the discipline:	
Name of discipline	Manufacturing practice
2. Prerequisites:	Technology of installation of electrical equipment and electrical installations
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Results of performance of tasks, registration of documents. Safety instructions (General). Safety training and workplace training. Familiarization with the enterprise and its power supply and automation system. Performance of production tasks. The study of theoretical material. Independent work with literature and technical documentation. Collection,

	processing, systematization and analysis of factual and literary materials.
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1. Basic information about the discipline:	
Name of discipline	Heat networks and heat supply systems
2. Prerequisites:	Theoretical foundations of heat engineering
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Heat consumers and their thermal loads. Construction of heat networks. Graphs of heat consumption. Vacation regulation. Heat carriers and their parameters. Calculation of parameters of a thermal network. Selection of network and make-up pumps. Calculation of forces on supports. The selection of the Elevator. Operation of automatic heat points.

1. Basic information about the discipline:	
Name of discipline	Electrosupply
2. Prerequisites:	Theoretical foundations of electrical engineering 1
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Basic concepts of electrical receivers and consumers of electricity. Modes of operation of electric receivers. Methods of calculation of electric loads. Center of electrical loads. Select the location of the power supply. Selection of cable and wire core cross-section. Selection of protective and switching equipment. Selection of power transformers. Switchgear equipment. Schemes of substations.

1. Basic information about the discipline:	
Name of discipline	Operation and repair of electrical equipment
2. Prerequisites:	Electric machines, Automated electric drive
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Basic concepts and definitions. Operational properties of electrical equipment. Reliability properties. Influence of quality of the electric power on work of electric receivers. Operational reliability of electrical equipment. Theory of acquisition and diagnostics of electrical equipment. General issues of capital repairs. Technology of overhaul of electric machines of direct and alternating current. Testing of electrical machines after repair. Technology of overhaul of power transformers. Drying of transformer windings.

1. Basic information about the discipline:	
Name of discipline	Production management
2. Prerequisites:	Fundamentals of Economics and law
3. Post-requisites:	-
4. The content of the discipline	Characteristics of the organization and management activities. The evolution of management thought. Internal and external environment of the organization. Social responsibility of business and ethics of Manager. Communication tools. Management decisions. Planning. Organization as a management function. Motivation. Control. Group dynamics. Leadership: power and influence. Leadership style. Conflict and stress management. Change control.

1. Basic information about the discipline:	
Name of discipline	Manufacturing practice
2. Prerequisites:	Training practice, Electric machines
3. Post-requisites:	Course and diploma design
4. The content of the discipline	The results of the tasks, paperwork. Safety instruction (General). Safety

	training and workplace instruction. Familiarization with the enterprise and its power supply and automation system. Performance of production tasks. The study of theoretical material. Independent work with literature and technical documentation. Collection, processing, systematization and analysis of factual and literary materials.
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1. Basic information about the discipline:	
Name of discipline	Design work
2. Prerequisites:	Power supply, Operation and repair of electrical equipment, electrical Technology
3. Post-requisites:	Course and diploma design
4. The content of the discipline	The importance of design in the implementation of complex electrification and automation of production. General requirements for the project. Stages of real design. Composition of the working project. The source materials for the design. Standard project. The procedure for coordination and approval of projects. The specifics of production and its consideration in the design. Design of fire alarm systems. Design of elements of heating, ventilation and Sewerage systems.

### Annex 4. Description of elective component disciplines

1. Basic information about the discipline:	
Name of discipline	Automated electric drive
2. Prerequisites:	Electric machine
3. Post-requisites:	Operation and repair of electrical equipment
4. The content of the discipline	Concept and definitions. Functions and requirements. Mechanical characteristics of production mechanisms, DC motors, asynchronous motors. Equation of motion of the electric drive. Reduction of moments and efforts. Transient processes in electric drives. Speed regulation of electric drives.

1. Basic information about the discipline:	
Name of discipline	Automated electric drive
2. Prerequisites:	Electric machine
3. Post-requisites:	Operation and repair of electrical equipment
4. The content of the discipline	Concept and definitions. Functions and requirements. Mechanical characteristics of production mechanisms, DC motors, asynchronous motors. Equation of motion of the electric drive. Reduction of moments and efforts. Transient processes in electric drives. Speed regulation of electric drives.

1. Basic information about the discipline:	
Name of discipline	Engineering graphics
2. Prerequisites:	-
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Methods of image spatial geo-metric figures on the plane. Methods for solving metric and positional problems in space from these images. Views, sections and cross-sections. Detachable and all-in-one connections. Detailing and sketching. COMPASS graphics editor. Autocad graphics editor.

1. Basic information about the discipline:	
Name of discipline	Electrical drawings
2. Prerequisites:	-
3. Post-requisites:	Course and diploma design
4. The content of the discipline	General information. Electrical diagrams, symbols used in circuits . Schematic diagram. Technique of reading circuit diagrams. Rules of execution of electrical circuits. Schematic diagrams of the electric drive. The content and purpose of connection schemes. Drawings of electrical devices. Drawings of power grids. Drawings of electric lighting networks. Automatic control schemes. Equipment of reading schemes of automation

1. Basic information about the discipline:	
Name of discipline	Theoretical mechanics
2. Prerequisites:	Physics
3. Post-requisites:	Automated electric drive
4. The content of the discipline	Basic concepts and axioms of statics. Arbitrary plane system of forces. Friction. Center of gravity. Kinematics of a point. Movement of a solid body. Basic theorems of dynamics. Stretching and compression. Shear and torsion. Bend. Basic theories of stress and strain state. Stability. The main provisions of the machine parts. Basic concepts about the transmission. Shafts and axles. Couplings: permanent, driven, self-driving.

1. Basic information about the discipline:	
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Name of discipline	Applied mechanics
2. Prerequisites:	Physics
3. Post-requisites:	Automated electric drive
4. The content of the discipline	Kinematic analysis of mechanisms. Ways to set movement. Friction in kinematic pairs. PERFORMANCE. Strength of materials. Gear. Details of machines. Structural material. Heat treatment. Kinematic and power calculation of the drive. Shafts, axles, couplings, bearings, springs.

1. Basic information about the discipline:	
Name of discipline	Math 2
2. Prerequisites:	Math 1
3. Post-requisites:	Theoretical foundations of electrical engineering 2
4. The content of the discipline	Basic concepts of probability theory. Types of random events. Classical definition of probability. The amount of events. The theorem of addition of probabilities of events.. Types of random variables. The law of probability distribution of a random variable. Numerical characteristics of discrete random variables. Continuous random variables. Numerical characteristics of continuous random variables. Problems of mathematical statistics. General population and stratified sampling.

1. Basic information about the discipline:	
Name of discipline	Applied problems of mathematics
2. Prerequisites:	Math 1
3. Post-requisites:	Theoretical foundations of electrical engineering 1
4. The content of the discipline	The concept of series. Numerical series. Functional series. Power series. Applications of Taylor and Fourier series. The concept of a complex number. Geometric representation of complex numbers. Forms of writing complex numbers. Operations on complex numbers. Fields of application of complex numbers

1. Basic information about the discipline:	
Name of discipline	Leadership and organization
2. Prerequisites:	Cultural studies and psychology
3. Post-requisites:	Production management
4. The content of the discipline	Theory and practice of career. The mechanisms of the career process. Career management strategy. Project activity. Career management in the organization. Business. Business organization. Innovative entrepreneurship. Forms of business. Procedure for registration of business entities. Bankruptcy and liquidation of the enterprise. Business infrastructure. Basic principles of management in business. Planning in business

1. Basic information about the discipline:	
Name of discipline	Theoretical foundations of electrical engineering 2
2. Prerequisites:	Math 2
3. Post-requisites:	Automation and control systems of technological processes
4. The content of the discipline	Switching laws. The inclusion of R, L, C at a constant voltage. Classical method of calculation. Application of Laplace transformations. Operator method of calculation. Elements and equivalent circuits of the simplest nonlinear circuits. Graphical methods of calculation. Basic concepts and laws of the magnetic field. Calculation of unbranched and branched magnetic circuits.

1. Basic information about the discipline:	
Name of discipline	Technology of installation of electrical equipment and electrical installations
2. Prerequisites:	-
3. Post-requisites:	Manufacturing practice

4. The content of the discipline	Basic concepts and definitions. Normative document. Classification of electrical installations. Organization of works. Wirings. Connection of wires and cables. Installation of electric motors. Installation of lighting electrical installations. Installation of electrical devices. Installation of controls and protection of electric motors. Installation of shields. Installation of transformer substations and switchgear. Device and installation of cable lines. Device and installation of overhead lines. Installation of grounding devices.
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1. Basic information about the discipline:	
Name of discipline	Automation elements and devices
2. Prerequisites:	-
3. Post-requisites:	Automation and control systems of technological processes
4. The content of the discipline	General information. Classification. Electromagnets, electromagnetic relays. Sensors of pressure, flow, level, temperature, humidity, concentration, movement, vibration and position, photo sensors. DAC. ADC. The device and principle of work of Executive mechanisms

1. Basic information about the discipline:	
Name of discipline	Instrumental energy audit
2. Prerequisites:	Physics
3. Post-requisites:	Energy management and audit
4. The content of the discipline	Energy management and audit Basics of energy audit. Content and main provisions. Legal and regulatory framework. Methodology, main types and stages of energy surveys. Normative consumption of energy resources. Energy consumption accounting. Methodological and thermographic survey of consumers. Instrumentation. Goals and objectives of the energy survey. The organization of power inspection, procedure, and presentation of results. Analytical review of energy activity. Energy efficiency assessment. Development of recommendations and activities. Energy passport.

1. Basic information about the discipline:	
Name of discipline	Linear automatic control systems
2. Prerequisites:	Theoretical foundations of electrical engineering 2
3. Post-requisites:	Automation and control systems of technological processes
4. The content of the discipline	Basic concepts and definitions. The object of control and influence on it. The composition of the SAR. Basic principles. Laws. Classification. Block diagram. Operating mode. The differential equation is linear. Dynamic characteristic. Transfer function, time characteristics. The frequency characteristics, the advanced features. The model links the dynamic Stability, stability criteria. Analysis of the quality of regulation..

1. Basic information about the discipline:	
Name of discipline	Electric lighting and irradiation
2. Prerequisites:	Physics
3. Post-requisites:	Electrical engineering, Course and diploma design
4. The content of the discipline	Physical basis of optical radiation. Emission spectra of the characteristic spectra. Artificial sources of radiation. Lighting products. The main characteristics of the device, spotlights. Oh. Calculation of floodlight. Lighting network. Calculation of section of wires and cables. Devices of switching, protection and control of lighting networks, characteristics, choice.

1. Basic information about the discipline:	
Name of discipline	Typical production mechanisms
2. Prerequisites:	Applied mechanics, Theoretical mechanics
3. Post-requisites:	Automation and control systems of technological processes

4. The content of the discipline	General information and classification of typical machines and mechanisms. Kinematic and energy schemes. Coordination of characteristics. Electric equipment and electric drive of pumping, ventilating and compressor installations. Electrical equipment and electric drive of lifting mechanisms. Electrical equipment and electric drive of mills, crushers, separators, centrifuges. Electrical equipment and electric drive of flow-conveyor installations. Electrical equipment and electric drive of earthmoving machines. Typical electric drives of metallurgical production.
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1. Basic information about the discipline:	
Name of discipline	Energy management and audit
2. Prerequisites:	Instrumental audit
3. Post-requisites:	Course and diploma design
4. The content of the discipline	Basic concepts of energy management. Matrix. Strategic approach. ISO 50001 information systems. The practice of implementation. Management in the energy sector. The process of conservation of energy. Economic assessment. Analysis of systems. Energy passport. The main stages of the audit. Methodology of energy audit.

1. Basic information about the discipline:	
Name of discipline	Nonlinear automatic control systems
2. Prerequisites:	Theoretical foundations of electrical engineering 2
3. Post-requisites:	Automation and control systems of technological processes
4. The content of the discipline	Typical nonlinear characteristics. Steady state. Stability in the "small", in the "big", in the "whole". Methods of stability research. The main characteristics of the pulse element. The application of the Laplace transform. System response. Analysis and synthesis of control systems. Sustainability, transients and quality. Frequency response. Synthesis of systems. Implementation of control laws methods of stability research.

1. Basic information about the discipline:	
Name of discipline	Energy saving by industry
2. Prerequisites:	Electric machine
3. Post-requisites:	Course and diploma design
4. The content of the discipline	General characteristics of production. Energy saving in lighting systems. Energy saving in power supply systems of industrial enterprises. Energy saving in buildings and constructions energy Saving and energy efficiency by means of the electric drive. Fundamentals of energy saving in heat technologies. Energy saving and ecology. Measures to save electricity

1. Basic information about the discipline:	
Name of discipline	Automation and control systems of technological processes
2. Prerequisites:	Automation elements and devices, Automated electric drive
3. Post-requisites:	Course and diploma design
4. The content of the discipline	General information. Requirements for automation systems. Types of technological processes. Sensors. Actuator. Typical production mechanisms. Control system. Accuracy, speed and quality of regulation. SCADA-system.

1. Basic information about the discipline:	
Name of discipline	Economy and organization of production
2. Prerequisites:	Fundamentals of Economics and law
3. Post-requisites:	
4. The content of the discipline	Fixed assets. Current assets. Labor resources of the enterprise. Salary. Cost of energy production. Pricing and tariffs in the industry. Economics of organization of operation and repair of power equipment. Fundamentals of the economy of energy supply of the enterprise. Economy of planning of

	work of power economy. Economics of management decisions. Technical and economic calculations in the energy sector. Investment projects of the energy enterprise. Project analysis.
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1. Basic information about the discipline:	
Name of discipline	Investment management
2. Prerequisites:	Fundamentals of Economics and law
3. Post-requisites:	
4. The content of the discipline	Basic concepts and definitions. Theoretical bases. Economic essence and classification of objects of investment activity. Concept, types and requirements. Efficiency evaluation. Risk factor and inflation accounting. Method of financing. Management of choice. Portfolio of financial investments. The essence and principles of the investment strategy. Foreign direct investment.

1. Basic information about the discipline:	
Name of discipline	Wind energy
2. Prerequisites:	Physics
3. Post-requisites:	Diploma design
4. The content of the discipline	The concept of wind energy cadastre. Wind regimes of Kazakhstan. Basics of aerodynamics. Air and its properties. Systems and classification of wind turbines. Aerodynamic calculation of the wind wheel. Methods of statistical processing of meteorological data on wind speeds. Determination of the design speed of the wind power plant. Wind energy calculations. Potential, technical and economic wind energy resources. Wind energy storage. Feasibility study of the use of wind power plants.

1. Basic information about the discipline:	
Name of discipline	Solar power
2. Prerequisites:	Physics
3. Post-requisites:	Diploma design
4. The content of the discipline	Fundamentals of meteorology. Solar radiation. Spectral distribution. Solar systems for generating electricity. Design of STS. Liquid and air systems. Solar energy collectors. Theory of calculation. Thermal loss. Methods to improve the efficiency of collectors. Air preheater. Grain dryer. Water vapor and air. Calculation of solar resources of the region. Potential, technical, economic resources. Photovoltaic generation. Designs. Technical and economic assessment of the use of solar installations.

1. Basic information about the discipline:	
Name of discipline	Industrial controller
2. Prerequisites:	Digital and microprocessor technology
3. Post-requisites:	Diploma design
4. The content of the discipline	General information about controllers. The architecture and types of PLC. Structure and principle of operation of controllers Siemens, Schneider Electric, ARIES. Programming and interface of controllers Siemens, Schneider Electric, ARIES. Additional modules Siemens, Schneider Electric, ARIES. Installation of modules Siemens, Schneider Electric, ARIES. Design of automation systems.

1. Basic information about the discipline:	
Name of discipline	Electrotechnology
2. Prerequisites:	Physics
3. Post-requisites:	Diploma design
4. The content of the discipline	Resistance heating. Induction heating. Electric arc technology. Plasma technologies and installations. Electron beam heating and laser technologies.

	The use of ultrasound. Electron-ion electrotechnologies. Use of electrostatic fields. Electrolysis technologies. Electrolyte technologies. Electroerosion echnology
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