

NON-PROFIT JOINT-STOCK COMPANY
ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY

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APPROVED
By the decision of the Academic
Council

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Board Member – Vice-Rector for
Academic Affairs


A.M. Temerbayeva



MODULAR EDUCATIONAL PROGRAM

in the direction of preparation 7M071 «Engineering »

7M07107 - «Power engineering»

Level: Master degree (1,5 years of study)

Awarded degree – «Master of Engineering and Technology»

Karaganda 2022

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Introduction

The modular educational program **7M07107 – «Power engineering»** is developed on the basis of the following regulatory documents:

Law of the Republic of Kazakhstan “On Education” dated July 27, 2007 No. 319-III ЗРК, with amendments and additions dated April 19, 2019 No. 250-VI.

Model rules for the activities of educational organizations of the corresponding types (Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No. 595, with amendments and additions dated January 9, 2019 No. 10).

State Compulsory Education Standards (SCES) of all education levels (Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 604).

Rules for the organization of the educational process on credit technology of education (Order of the Minister of Education and Science of the Republic of Kazakhstan dated April 20, 2011 No. 152, as amended and supplemented on October 12, 2018 No. 563).

The qualification directory of positions of managers, specialists and other employees, approved by order of the Minister of Labor and Social Protection of the Republic of Kazakhstan dated May 21, 2012 No. 201-ө-м, as amended and supplemented from April 17, 2013 No. 163-ө-м.

A modular educational program is a comprehensive document that defines the goals, objectives and results of education, the structure and content of working curricula and programs, methods and methods for their implementation, educational and methodological and resource support of the educational process and criteria for assessing students' academic achievements.

1 Objectives of the Modular Education Program

The application of this Modular educational program provides for the achievement of the following goals:

- in practice, implement democratic principles of educational process management, expand academic freedom and the capabilities of higher education institutions;
- to ensure the adaptation of higher education in the specialty and scientific research to the changing needs of society and the achievements of scientific thought;
- ensure recognition of the level of training of specialists in other countries;
- provide higher mobility of graduates in changing labor market conditions;
- training for the organization of the operation of production systems, transmission and consumption of thermal energy.

2 Passport of the Modular educational program

2.1 List of qualifications and positions

Graduate for this Modular Education Program awarded degree «**Master of Technical Sciences**».

Qualifications and positions are determined in accordance with the “Qualification directory of positions of managers, specialists and other employees”, approved by order of the Minister of Labor and Social Protection of the Republic of Kazakhstan dated May 21, 2012 No. 201-ø-m, with amendments and additions from 04.17.13 No. 163-ø-m.

2.2 Graduation Qualification

2.2.1 Professional activity

The sphere of professional activity of graduates is industry, science, education, culture, healthcare, agriculture, public administration.

2.2.2 Objects of professional activity

The objects of professional activity of graduates are enterprises and organizations of various forms of ownership that develop, implement and operate automated control systems in various fields of human activity.

2.2.3 Subject of professional activity

The subjects of professional activity of graduates are mathematical, informational, software, linguistic, technical and legal support of automatic control systems for various processes and mechatronic and robotic objects, including design, development, implementation, maintenance and operation technologies.

2.2.4 Types of professional activity

«**Master of Technical Sciences**» under the educational program **7M07107** – «**Power engineering**» can perform the following types of professional activities:

production and technological: - knowledge, understanding, ability to evaluate and make decisions necessary for the formation of the required operating modes of automated technical systems and mechatronic and robotic objects; - the ability to assess the impact of automatic control systems on the environment and social sphere; - conducting a feasibility and environmental analysis of the impact of the introduction of automatic control systems on the environment and social sphere.

design and engineering: - assessment, examination and development of automation and control projects for facilities and processes for various purposes; - Evaluation and examination of projects of automation systems using modern management methods, including intelligent control systems; - development of specialized software for projects of automated process control systems; - installation, parameterization, commissioning, operation and repair of control systems and control of production processes and mechatronic and robotic objects; - carrying out acceptance tests of control systems and control of production facilities.

research: - performance analysis and dynamic changes in technological processes; - development of plans, programs and methods for testing control systems and control of production facilities; - the creation of tools and methods for predicting the state and possible behavior of control systems and control of production processes and mechatronic and robotic objects.

scientific and pedagogical: - conducting training activities in the disciplines of the electric power industry; - application and development of new educational technologies, including computer and distance learning systems.

organizational and management: - organization of the activities of the staff of the department and / or enterprise; - development and implementation of measures to ensure energy conservation of designed and operated production facilities; - development of measures for the organization of the operation of technical means of measuring and controlling parameters of controlled objects and processes.

2.2.5 Professional Functions

The main functions of the professional activities of graduates in the field of robotics and control systems are: - research; - design; - installation and commissioning; - exploitation; - administration; - accompaniment.

2.2.6 Areas of professional activity

Areas of professional activity include:

- development, implementation and operation of control systems for technical facilities of mechatronics and robotics;
- development, implementation and operation of automated process control systems;
- development, implementation and operation of control systems for technological equipment and complexes.

3. Map of the Modular Education Program

Module code and name	Code and name of discipline	Cycle / component discipline	Form of control	Term	The volume of credits	Formed competencies
1	2	3	4	5	6	7
BD - The cycle of basic disciplines						
UC - University component						
PM 1 Module psychological and management	ManPM 5101 Management, psychology of management	BD/UC	Exam	1	3	<p>Need to know: functional and stylistic characteristics of the scientific presentation of the material in the studied foreign language; general scientific terminology and terminological sublanguage of the corresponding specialty in a foreign language; basics of business correspondence in the framework of international cooperation.</p> <p>Need to be able: freely read authentic literature on the relevant branch of knowledge in a foreign language and draw up information extracted from foreign sources in the form of a translation, abstract, annotation; distinguish between types and genres of reference and scientific literature; use etiquette forms of scientific communication; express in writing your thoughts on topics related to scientific work (scientific article, theses, report, translation, abstracting and annotation);</p> <p>Need to Have Skills: oral communication in the specialty in the forms of monologue, dialogue / polylogue, preparation of written forms for the presentation of informational, scientific, professional and business material in the specialty, work with lexicographic sources in a foreign language; the use of psychological methods in the study of personality; the formation of a new and improvement of the existing structure of enterprise management, the solution of economic situations, the effective use of the principles and methods of management in the field of planning, organization, motivation and control of the enterprise, determining the effectiveness of production management; essence and types of management, elements of social responsibility and ethics of firms, interpersonal and organizational communications, the basics of managerial decision making, models and methods of decision making, the basics of leadership, effective motivation and conflict resolution; translation of texts from Kazakh into Russian and from Russian into Kazakh, improvement of knowledge acquired in business Kazakh when used in various situations; features of types of documents, their improvement and vocabulary, the correct use of professional terms when writing documents.</p> <p>Need to be competent: in a variety of methodological approaches; in the independent formulation and solution of complex theoretical and applied problems in this branch of science; in the use of a foreign language in speech scientific and professional communication situations at the international level. the application of scientific and methodological foundations of management in the practical activities of the enterprise; in methods of psychological research; in solving urgent psychological problems in the organization and management of production activities; in the use of the state language in speech scientific and professional communication situations; in self-</p>

						development of professional language skills.
	FLp 5102 Foreign language (professional)	BD/UC	Exam	1	3	<p>Need to know: functional and stylistic characteristics of the scientific presentation of the material in the studied foreign language; general scientific terminology and terminological sublanguage of the corresponding specialty in a foreign language; basics of business correspondence in the framework of international cooperation.</p> <p>Need to be able: freely read authentic literature on the relevant branch of knowledge in a foreign language and draw up information extracted from foreign sources in the form of a translation, abstract, annotation; distinguish between types and genres of reference and scientific literature; use etiquette forms of scientific communication; express in writing your thoughts on topics related to scientific work (scientific article, theses, report, translation, abstracting and annotation);</p> <p>Need to Have Skills: oral communication in the specialty in the forms of monologue, dialogue / polylogue, preparation of written forms for the presentation of informational, scientific, professional and business material in the specialty, work with lexicographic sources in a foreign language; the use of psychological methods in the study of personality; the formation of a new and improvement of the existing structure of enterprise management, the solution of economic situations, the effective use of the principles and methods of management in the field of planning, organization, motivation and control of the enterprise, determining the effectiveness of production management; essence and types of management, elements of social responsibility and ethics of firms, interpersonal and organizational communications, the basics of managerial decision making, models and methods of decision making, the basics of leadership, effective motivation and conflict resolution; translation of texts from Kazakh into Russian and from Russian into Kazakh, improvement of knowledge acquired in business Kazakh when used in various situations; features of types of documents, their improvement and vocabulary, the correct use of professional terms when writing documents.</p> <p>Need to be competent: in a variety of methodological approaches; in the independent formulation and solution of complex theoretical and applied problems in this branch of science; in the use of a foreign language in speech scientific and professional communication situations at the international level. the application of scientific and methodological foundations of management in the practical activities of the enterprise; in methods of psychological research; in solving urgent psychological problems in the organization and management of production activities; in the use of the state language in speech scientific and professional communication situations; in self-development of professional language skills.</p>
EC - Elective component						
MAEPI 2 Module Modern aspects of electric power industry	MTMMCACS 5103 Modern theories, methods and means of creating automation and control systems	BD/UC	Exam	1	5	<p>MTMMCACS 5103 Modern theories, methods and means of creating automation and control systems</p> <p>Need to know: methods for mathematical description, research, and design of continuous and discrete objects, methods for studying the properties of continuous and discrete automatic control systems (ACS), the principles of constructing special ACS, the structure of automated process control systems (ACS) and production (ACS), tuning methods and ways of their development; principles of building integrated hierarchical control and monitoring systems based on local and global telecommunication networks; methods for evaluating and analyzing stochastic processes,</p>

						<p>phenomena and events.</p> <p>Need to be able: carry out the formulation of tasks of research, design, configuration and commissioning of automation and control systems; apply theoretical information to solve the practical problems of self-propelled guns of technological processes and industries; make verification calculations, navigate in the ACS schemes of typical technological processes; based on analysis of the subject.</p> <p>Need to Have Skills: design, configuration and commissioning of automation and control systems for various purposes; solving problems of analysis, synthesis and optimization of self-propelled guns using specialized application packages.</p> <p>Need to be competent: in the independent application of knowledge and skills gained in the discipline for the analysis and development of new electrical objects, technologies and automatic control systems.</p> <p>//MPEPI 5103 Modern problems of electric power industry</p> <p>Need to know: energy conservation in the energy sector, methods for increasing the efficiency of energy conversion in the production and transmission of electricity; features decentralization of energy supply; new materials in the energy sector.</p> <p>Need to be able: to understand the current problems of the electric power industry, issues of transmission of electric energy; to increase the technical and economic indicators of the main equipment.</p> <p>Need to Have Skills: on the selection of economic and science-based standards and conducting experiments on the effectiveness of the implementation of ETEA; determination of specific indicators of resource consumption; developing a business case for introducing new technical solutions.</p> <p>Need to be competent: in modern electric power industry and its basic problems; in the prospects for the development of traditional energy sources; in the problems of interaction between energy and ecology.</p>
	//MPEPI 5103 Modern problems of electric power industry					
	ESTPIA 5105 Energy-saving technologies in power industry and automation	БД/ КВ	Экзамен	1	4	<p>ESTEPIA 5105 Energy-saving technologies in the electric power industry and automation</p> <p>Need to know: management objects in technical systems (ATS); industrial automatic control systems; means of automation of technical systems; features of automation of continuous and discrete technical systems; logical control algorithms; management of complex systems; methods of mathematical modeling of objects and systems; methods for implementing optimal control in technical systems; automation schemes for typical technical systems; properties of typical control systems for electrical complexes (CSEC), their structures and principles of operation; modern energy-saving technologies in the electric power industry and automation (ETEA), energy characteristics of technological objects of mining and metallurgical enterprises, forms and methods of conducting energy examinations of objects for various purposes, the principles of operation of heat and electric equipment.</p> <p>Need to be able: based on the analysis of the subject area, develop requirements for the management of electrical complexes, including ATS, CSEC and ETEA; apply in application activities the methods and algorithms of ATS and CSEC for various industries; identify possible causes of irrational methods of production and wasteful use of energy in industry; develop schemes and select modern equipment for automatic telephone exchanges, CSEC and ETEA; make calculations and design of energy-using equipment, installations, systems and technologies,</p>

						<p>taking into account the criterion of energy conservation; make verification calculations, navigate in the ATS schemes of typical technological processes and CSEC; configure ATS and CSEC for various purposes.</p> <p>Need to Have Skills: performance of work on the selection of equipment for the management of electrical complexes, including for automatic telephone exchanges and CSEC of various industries; settings of analog and digital controllers; determination of parameters of technical objects, automation of many connected systems and systems with delay; on the parameterization, commissioning and research of CSEC; on the selection of economic and science-based standards and conducting experiments on the effectiveness of the implementation of ETEA; determination of specific indicators of resource consumption.</p> <p>Need to be competent: in the field of management of electrical complexes, including ATS, CSEC, ETEA; in modern schemes, methods and means of automatic telephone exchange, CSEC and ETEA of various manufactures; in methods of optimizing the energy consumption of the main technological processes, machines, mechanisms, assemblies and installations of technological processes using automatic control theory methods, as well as in the field of integrated solution of design problems for control systems of electrical complexes containing automatic telephone exchanges and CSEC taking into account energy efficiency and the required operating modes of units and technological lines for various applications and various operating conditions.</p> <p>// EE 5104 Energy Saving and energy Audit</p> <p>Need to know: the main provisions of the regulatory framework and documents on energy-saving policies; goals, objectives, principles, organization and methodology of energy audit; basics of rationing, energy planning; composition and methods of developing energy-saving projects; ways to reduce power consumption.</p> <p>Need to be able: determine the goals and objectives of energy audit; calculate energy consumption, costs and energy flows; perform analysis of energy consumers, distribution systems, energy conversion efficiency; make lists of energy-saving measures, conduct their examination; provide energy audit reporting data;</p> <p>Need to Have Skills: on the implementation of regulation and the implementation of energy planning; make calculations in energy-saving projects, including using computers.</p> <p>Need to be competent: in qualitative and quantitative proportions in electrical and magnetic circuits and the main ways of solving problems posed by special electrical engineering disciplines; qualitative and quantitative methods of energy audit, and the main ways of planning energy consumption</p>
	///ESEA 5104 Energy saving and energy audit					
PD – Cycle of professional disciplines						
UC - University component						
IP 3 Module Industrial practice	K(R)L(Prof) 5201 Kazakh (Russian) language (professional)	PD/UC	Exam	1	5	<p>Need to know: norms of the literary language; definition: text, main idea, topic and paragraph of text; functional styles of speech, their signs and rules of use; features of oral and written business communication; composition and requirements for the language of public speaking; about lexical and grammatical units on the basis of information and training texts; about the ability to distinguish between the features of written and oral types of business and scientific styles; about the functional styles of the language, the scope of their use, about the main style features and</p>

						<p>linguistic features; about the features of oral public speech; about the history, literature, customs, traditions, science, art, poets-writers of the Kazakh people: about the main speech thematic-composite types - monologue-description, monologue-reasoning, monologue-exposition, monologue-analysis, dialogue-story; successful mastery of types of speech activity in accordance with level training;</p> <p>Need to be able: analyze the structural and semantic organization of the text; determine the language means of organizing the text; determine the structural and semantic features of texts of various styles; work with texts of different styles and genres based on the implementation of a system of tasks and training exercises; to carry out the correct choice and use of language and speech means for solving certain problems of communication and cognition on the basis of knowledge of a sufficient amount of vocabulary, a system of grammatical knowledge, pragmatic means of expressing intentions;.</p> <p>Need to Have Skills: express your opinion: learn to write a monologue-description, organize a conversation, debate; to develop the ability to speak using professional vocabulary, to form the ability and skills to speak actively, in a generalized way; request and communicate information in accordance with the situation of communication, evaluate the actions and deeds of participants, use information as a tool to influence the interlocutor in situations of knowledge and communication in accordance with certification requirements; build speech behavior programs in situations of personal, social and professional communication in accordance with the norms of the language, culture, specifics of the sphere of communication, certification requirements;</p> <p>Need to be competent: in the process of mastering all types of speech activity and the basics of oral and written speech; in understanding various types of communicative statements, as well as in building coherent and logical statements of different functional styles; in discussing ethical, cultural, socially significant problems, expressing one's point of view, in the ability to defend it with arguments, to critically evaluate the opinion of interlocutors; in the process of communication in various situations of different spheres of communication in order to realize their own intentions and needs (household, educational, social, cultural);</p> <p>Need to know: methods of processing the empirical data obtained and their interpretation; the main production tasks, the structure of services involved in the development, improvement and operation of facilities equipped with electric drives at the enterprise; methods of organizing the operation of control systems; methods of training performers in the rules of operation of electrical systems.</p> <p>Need to be able: independently formulate the production task for the current moment and for the near future on automation of production processes; draw up the results of the work performed; collect data to analyze the use and functioning of automatic control systems; modernize individual elements of automatic control systems in accordance with the work assignment; document the changes made and compile accounting documentation; build relationships with the team; possess methods of analysis and introspection that contribute to the development of the personality of the team leader; make informed conclusions on production activities; justify the adopted action plan, adequately select tools and methods to solve the tasks.</p> <p>Need to Have Skills: using methods of organizing and carrying out installation and commissioning works in the field of automation of control facilities; using instrumental and</p>
	PP 5202 Industrial practice	PD/UC	Exam	2	5	

						software tools for processing information about the operation of control systems for production and mechatronic facilities; implementing regulations for updating, maintenance and restoration of automatic control systems; working with technical documentation; conducting production discussions without violating the laws of logic and the rules of argumentation. Need to be competent: in building a model of professional tasks and meaningful interpretation of the results obtained; in designing, adapting and implementing standard automation processes of technological processes and objects of mechatronics and robotics; in maintaining operational and organizational and administrative production documentation.
PD – Cycle of professional disciplines						
UC - University component						
MES 4 Module Modeling of electrical systems	IMS 5203 Identification and modeling of systems	PD/UC	Exam	1	5	Need to know: types of models and basic methods for constructing mathematical models of technological systems; on the current state and development of methods of mathematical modeling and experimental research of control objects of automatic systems; a systematic approach to the problem of identification; methods of structural and parametric identification of control objects; the basics of computer simulation; methods for processing the results of experimental studies. Need to be able: apply modeling methods in the formulation and solution of problems of analysis and improvement of existing and planned technological processes and industries; formulate a statement of the identification problem; solve the problems of structural and parametric identification of various systems; choose identification algorithms; apply specialized application packages (such as Matlab) to solve problems. Need to Have Skills: building mathematical models of technological systems with lumped parameters; determining the parameters of the equations of statics and the parameters of the equations of dynamics when using the experimental-analytical method of compiling a mathematical description of the technological process Need to be competent: in the independent application of knowledge and skills gained in the discipline for the analysis and development of new electrical objects, technologies and automatic control systems.
	//TE 5203 Theory of experiment					//TE 5203 Theory of experiment Need to know: the basic principles of conducting experimental research; methods of interpretation of experimental results; methods of processing experimental data; Need to be able: make planning matrices for a complete factor experiment and fractional factor experiment; choose a mathematical model to describe the process studied during the experiment; determine the regression equation using experimental data; Plan orthogonal and rotatable second-order experiments; Need to Have Skills: in self-application means the skills acquired in the discipline to develop optimal plans for the experiment. Need to be competent: in the independent application of knowledge and skills acquired in the discipline for the analysis and development of new electrical facilities, technologies and automatic control systems.

	EDCS 5204 Electric drive control systems	PD/UC	Exam	3	5	<p>EDCS 5204 Electric drive control systems</p> <p><i>Need to know:</i> management objects in technical systems; industrial automatic control systems; means of automation of technical systems; features of automation of continuous and discrete technical systems; logical control algorithms; management of complex systems; automation schemes for typical technical systems; properties of typical electric drive control systems, their structures and principles of operation.</p> <p><i>Need to be able:</i> based on the analysis of the subject area to develop requirements for the management of electric drives; apply in applied activities methods and algorithms for controlling electric drives for various industries.</p> <p><i>Need to Have Skills:</i> performance of work on the selection of equipment for controlling electric drives in various industries; on parameterization, commissioning and research of electric drive control systems;</p> <p><i>Need to Have Skills:</i> in the field of electric drive control; in modern schemes, methods and means of automation of automatic control systems for electric drives of various industries.</p>
	// NTRES 5204 Non-traditional and renewable energy sources	PD/UC	Exam	3	5	<p>// NTRES 5204 Non-traditional and renewable energy sources</p> <p><i>Need to know:</i> state and prospects of development of renewable energy sources in Kazakhstan; types and classification of alternative and renewable energy sources; principles of operation of alternative alternative energy sources; environmental problems arising from the use of renewable energy sources.</p> <p><i>Need to be able:</i> to develop a plant diagram for generating electrical energy using solar panels; calculate solar panels and solar collectors, evaluate the power obtained by using heat pumps and wind turbines.</p> <p><i>Need to Have Skills:</i> to collect the installation for generating electrical energy using solar panels; calculation of solar panels and solar collectors, heat pumps and wind turbines.</p> <p><i>Need to be competent:</i> in the use of unconventional energy sources for generating electric and thermal energy; in the problems of interaction between energy and ecology.</p>
	MED 5205 Modeling of electric drives	PD/UC	Exam	2	6	<p><i>Need to know:</i> software and technologies for modeling electromechanical systems; power unit of adjustable electric drives; control systems; simulation experiment methods.</p> <p><i>Need to be able:</i> to develop - programs of simulation experiments, mathematical and simulation models of objects of electrical complexes and technological processes of manufacturing enterprises.</p> <p><i>Need to Have Skills:</i> work with MATLAB and Electronics Workbench software libraries, calculation of simulation model coefficients; execution of work on the selection of methods for interfacing program blocks developed using various MATLAB libraries.</p> <p><i>Need to be competent:</i> in modern types of electromechanical converters of direct and alternating current, to understand the development trends of power converting equipment and control systems.</p>

	//ET 5205 Electrotechnology					<p>//ET 5205 Electrotechnology <i>Need to know:</i> the main sections of the natural science disciplines related to the theory of the discipline under study, and be prepared to study the basic laws in professional activity, apply methods of analysis and modeling of situations of theoretical and experimental research; standard methods for calculating and designing equipment elements and objects of activity (systems) as a whole using normative documentation and modern methods of searching and processing information; methods of conducting a feasibility study of design developments. <i>Need to be able:</i> analyze scientific and technical information, study domestic and foreign experience on the subject of activity; analyze existing systems and their elements, develop and implement the necessary changes in their structure from the standpoint of increasing efficiency and energy saving; to conduct a pilot industrial and scientific experiment according to the given methods and analyze the results with the involvement of the appropriate mathematical apparatus; assess the technical condition and residual life of equipment, organize professional inspections and maintenance <i>Need to Have Skills:</i> in the methodology for the feasibility study of design developments <i>Need to be competent:</i> in the selection of technological equipment and tools for the manufacture of specific products</p>
ADFPS 5 Module Automation and design of facilities in the power sector	PSEC 5206 Power supply of electrical complexes	PD/UC	Exam	1	5	<p>PSEC 5206 Power supply of electrical complexes <i>Need to know:</i> classification of elements of electrical complexes. Control gear with power semiconductor elements. Dynamic properties of induction motors. Characteristics of stepper motors, DC motors; controlled electric power converters. <i>Need to be able:</i> to make a choice of electrical equipment in accordance with the technological requirements of manufacturing enterprises; <i>Need to Have Skills:</i> to determine the dynamic properties of the elements of electrical complexes and the study of transients in the power systems of the complex and its individual equipment. <i>Need to be competent:</i> in the main types of mass-produced equipment of electrical complexes used in modern industrial enterprises, their characteristics, applications.</p>
	//ITPI 5206 Information technologies in power industry					<p>//ITPI 5206 Information technologies in power industry <i>Need to know:</i> normative and technical documentation in the field of designing power supply systems; the main stages of the process of designing systems of secondary (low voltage) circuits; power system design process. <i>Need to be able:</i> master the methods for solving the problems of designing systems of secondary (low voltage) circuits of the design object; the formation of skills in the development of systems of secondary (low voltage) circuits of the design object, the selection of electrical equipment of secondary circuits; the formation of skills in the use of reference and regulatory literature on the development of systems of secondary (low voltage) circuits of the design object, working with standard projects for the organization of systems of secondary (low voltage) circuits</p>

						<p>Need to Have Skills: in designing the latest energy technologies, depending on external conditions.</p> <p>Need to be competent: in the basic scientific principles of the program of modernization and technical re-equipment of the production base of the power system using methods of quantitative transformation and the introduction of new advanced technologies; know the device, the principle of operation and the basics of operation of computer technology installations.</p>
	PIC 5207 Programming of industrial controllers	PD/UC	Exam	2	5	<p>PIC 5207 Programming of industrial controllers</p> <p>Need to know: classification of MEAs; principles of microprocessor systems; basics of assembly language programming; interfaces and input / output devices; single-chip microcontrollers; nomenclature of microcontrollers of the PIC16F8xx family; indirect addressing, stack in pic16f877 microcontroller; input / output ports.</p> <p>Need to be able: to design nodes included in the objects of technological control and management, including those based on microprocessor control systems; read and understand simple circuits of typical electronic equipment on a digital integrated element base; select the necessary elements according to the reference information, in accordance with the working conditions of the elements in the circuit.</p> <p>Need to Have Skills: work with tools and hardware, testing and debugging software of industrial controllers and microprocessor systems.</p> <p>Need to be competent: in modern types of microcontrollers, architecture, design tools; to understand the development trends of microcontrollers and microprocessor technology.</p>
	//EST 5207 Engineering and smart technologies	PD/UC	Exam	2	5	<p>Need to know: regulatory and technical documentation in the field of power supply systems design; the main stages of the process of designing secondary (low-voltage) circuits; the process of designing power supply systems.</p> <p>Need to be able: master the methods of solving the problems of designing systems of secondary (low-voltage) circuits of the design object; formation of skills in developing systems of secondary (low-voltage) circuits of the design object; formation of skills in the use of reference and normative-technical literature on the development of secondary (low-voltage) circuits of the design object, working with standard projects for the organization of secondary (low-voltage) circuits</p> <p>Need to Have Skills: the ability to develop the main sections of complex projects of power supply systems; the basic concepts of the design process, the structure and classification of CAD, types of CAD support, the place of CAD in integrated systems, the relationship of CAD with PLM, PDM systems and technological design systems, the purpose, functions of CAD subsystems, SAM, SAE.</p> <p>Need to be competent: in the methods of solving problems of designing power supply systems using computer-aided design tools, obtaining knowledge by undergraduates on the basics of designing complex systems.</p>

	<p>AECMMP 5208 Automation of electrotechnical complexes of mining and metallurgical production</p> <p>//DORES 5208 Design and operation of renewable energy plants</p>	PD/UC	Exam	2	5	<p>Need to know: the structure of automated process control systems (ACS TP) and production (ACS), tuning methods and ways of their development; principles of building integrated hierarchical control and monitoring systems based on local and global telecommunication networks; methods for evaluating and analyzing stochastic processes, phenomena and events; properties and operation features of typical systems of electrical complexes, their structures, configuration principles; have an idea: about the main types of mass-produced equipment of electrical complexes used in modern industrial enterprises, their characteristics, applications; management objects in automation systems of electrical complexes of general industrial production (AEC GMP); automation schemes of typical technical systems and properties of typical systems of AEC GMP, including control systems for equipment, technological processes and production of AEC GMP, their structures and principles of operation.</p> <p>Need to be able: carry out the formulation of research, redesign, tuning and commissioning of automation and control systems; apply theoretical information to solve the practical problems of self-propelled guns of technological processes and industries; make verification calculations, navigate in the ACS schemes of typical technological processes; to make a choice of electrical equipment in accordance with the technological requirements of production enterprises; based on the analysis of the subject area, develop requirements for the AEC GMP; apply in applied activities the methods and algorithms of the AEC GMP; develop schemes and select modern equipment for the AEC GMP.</p> <p>Need to Have Skills: design, configuration and commissioning of automation and control systems for various purposes; solving problems of analysis, synthesis and optimization of self-propelled guns using specialized application packages; determination of the dynamic properties of the elements of electrical complexes and the study of transients in the power systems of the complex and its individual equipment; performance of work on the selection of equipment for the AEC GMP; settings of analog and digital controllers; on parameterization, adjustment and research of AEC GMP systems.</p> <p>Need to be competent: in choosing methods and means of creating automation and control systems; in modern equipment of electrical complexes; in the field of AEC GMP; in modern schemes, methods and tools of AEC GMP systems.</p> <p>//DORES 5208 Design and operation of renewable energy plants</p> <p>Need to know: the theory of the ideal and the basics of the design and operation of a wind power installation, classification and arrangement of wind turbines; design and operation of hydropower facilities, classification of hydroturbines and hydraulic structures; theoretical and physical foundations of the conversion of solar energy into heat and electricity, the basics of the design and operation of solar heat and power systems; fundamentals of design and operation of facilities that convert the energy of sea waves and currents into electrical;</p> <p>Need to be able: develop rational energy supply schemes for autonomous consumers on the basis of non-renewable energy sources; to carry out structural and verification calculations of energy supply systems based on alternative and renewable energy sources.</p> <p>Need to Have Skills: in using the basic principles of rational design and calculation of energy supply systems based on non-traditional and renewable energy sources.</p> <p>Need to be competent: knowledge of the problems and prospects for the development of alternative and renewable energy sources; about environmental problems of their use;</p>
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<i>ERWM and final certification</i>						
FERW 6	ERWMS 5301 Experimental research work of a master student, including internship and master's project	ERWM	Exam	3	18	<p>Need to be able: substantiate the relevance of the chosen topic and characterize the current state of the studied problem; select and study the main literary sources used as a theoretical basis for research; to review and review scientific publications to find non-standard solutions to emerging problems; collect data to analyze the functioning of the developed automatic control system; use links to relevant provisions of the educational and scientific literature.</p> <p>Need to know: used methodological apparatus; methods of organizing the operation of control systems to assess their applicability as part of a dissertation research; models and methods for identifying automatic control systems and their elements; application packages for simulation of mechatronic and robotic objects and their control systems.</p> <p>Need to Have Skills: compiling a review of the literature on the topic of the dissertation research in general and term paper in particular, which is based on relevant research publications and contains an analysis of the main results and provisions obtained by leading experts in the field of research; conducting an experiment; collection and processing of actual material for the thesis; assessing the reliability of the results and their sufficiency for completing the dissertation.</p> <p>Need to be competent: in work on literary sources that reveal the theoretical aspects of the issue under study, primarily with scientific monographs and articles of scientific journals.</p>
	DDMD 5302 Design and defense of master's dissertation	MRW	Defense of a master's thesis	3	12	<p>Need to know: how to draw up the results of work performed; collect data to analyze the use and functioning of heat production systems; modernize individual elements of heat supply systems in accordance with the work task; document the changes made and prepare reporting documentation; build relationships with the team; own methods of analysis and introspection that contribute to the development of the personality of the leader of the group; make informed conclusions on production activities; substantiate the adopted action plan, adequately select the means and methods for solving the tasks; QMS University standard "Methodical instruction. Graduation design. General requirements for organization and conduct "; the order of submission of the contents of the explanatory note to check for plagiarism.</p> <p>Need to be able: correctly formulate tasks in accordance with the topic of the dissertation; to solve the tasks, use the methods acquired in the development of theoretical and practical courses in the field of automation of production processes, production technology, socio-economic activities of the enterprise; use literary sources, including the Internet, in preparing and writing a graduation project; structured, concise and competent to draw up an explanatory note using graphic information (drawings, diagrams, flowcharts, formulas), in accordance with the university standard; to carry out the technical documentation of the project in accordance with GOST; work with Windows OS and its applications, with MATLAB RFP and Simulink library; use the PowerPoint application when preparing a project presentation.</p> <p>Need to Have Skills: in work with technical documentation; conducting production discussions without violating the laws of logic and the rules of argumentation; compiling a review of the literature on the topic of the dissertation research, which is based on relevant research publications and contains an analysis of the main results and provisions obtained by leading experts in the field of research; conducting an experiment; collection and processing of actual material for the thesis; assessing the reliability of the results and their sufficiency for completing</p>

					<p>the dissertation; presentation of materials of the practical part of the study in the form of computer presentations, reports, reports, etc. analysis of the operated or implemented automatic control systems at the enterprise; collection, systematization and generalization of practical material for use in the final project; clear and logical formulation of their thoughts; public protection of proposed solutions. work with Windows OS, RFP for calculating engineering systems; SCADA system applications.</p> <p><i>Need to be competent:</i> in work on literary sources that reveal the theoretical aspects of the issue under study, primarily with scientific monographs and articles in scientific journals; in arguing and upholding the main provisions of the dissertation; in the preparation of the final text of the master's thesis and in the report on the results of the dissertation research in the methodology for analyzing the subject area, designing power supply systems for industrial enterprises; features of their development and operation, in the application of the knowledge gained in solving specific scientific, technical and industrial-economic problems; in matters of organization, planning, conducting all types of professional activities; in all aspects of professional activity. in matters of organization, planning, conducting all types of professional activities; in all aspects of professional activity.</p>
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4. A summary table reflecting the amount of credits disbursed in terms of modules of the educational program:

Course of Study	Term	The number of mastered modules	Number of disciplines studied			The volume of credits						Amount		
			OK	BK	KB	Theoretical training	Teaching practice	Research practice	Experimental research work of a graduate student, including master project	Execution and defense of a master's thesis	Total	Total hours	Exam	Graded credit (CP, CW)
5	1	7	-	2	5	30					30	900	7	-
	2		-	4	3	30	10				30	900	5	-
6	3	-	-	-	-	-			18	12				-
	4		-	-	-	-								-
Total:		7	-	6	8	60	10		18	12	60	1800	12	-

1 DEVELOPED

Creators:

Neshina E.G. acting head of the Department of ES, Yugai V. V. acting head of the Department of APP, Brazhanova D.K. lecturer of the department of ES

DISCUSSED

2.1 At a meeting of the department «Energy systems»

Protocol from « ___ » _____ 2022 year, № ____.

Acting Head of Department _____ Neshina E.G

2.2 At a meeting of the department APP

Protocol from « ___ » _____ 2022 year, № ____.

Head of Department _____ Yugai V. V.

2.3 At a meeting of the Educational and Methodological Board FEAT

Protocol from « ___ » _____ 2022 year, № ____

The chairman _____ Aldoshina O. V.

2.4 The modular educational program was reviewed and approved at a meeting of the Academic Council

Protocol from « ___ » _____ 2022 year № ____.