

Considered
at the meeting of the Academic
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Minutes No. __
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APPROVED
Chairman of the Board
"S. Seifullin Kazakh
Agrotechnical University" JSC
_____ A.K. Kurishbayev
" ____ " _____ 2019

EDUCATIONAL PROGRAM
"Electrical complexes and systems"

Code and classification of the field of education	8D07 Engineering, manufacturing and construction industries
Code and classification of areas of training	8D071 Engineering and Engineering
International Standard Classification of Education Code	0710
Awarded degree	Doctor (PhD)
Training period	3 years
Form of study	full-time
Language of instruction	state / Russian

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Educational program " Electrical complexes and systems "
Considered at a meeting of the department "Power supply"
Minutes No. 13 of 04/18/2019

Head of the Department of "Power supply" G.G. Tatkeeva

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Dean of the Faculty of Energy S.S. Isenov

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1 Passport of the educational program

1.1 The purpose of the educational program

The educational program "Electrical complexes and systems" was created on the basis of an analysis of the current state of the economy in the field of energy, taking into account the requirements of the labor market, trends in the development of the electric power industry and the request of employers. Training, taking into account the country's development prospects, competitive highly qualified personnel with high spiritual and moral qualities, capable of independent thinking and ensuring progressive scientific, technical, socio-economic and cultural development of society.

The purpose of the educational program is to train highly qualified specialists with in-depth scientific training, capable of formulating and solving modern scientific and practical problems in science and production in the field of electric power.

1.2 General characteristics of the educational program

The educational program "Electrical Complexes and Systems" was developed in accordance with the National Qualifications Framework and Professional Standards, agreed with the Dublin descriptors and the European Qualifications Framework, on the basis of state general education standards of education at all levels of education (Order of the Minister of Education and Science of the Republic of Kazakhstan No. 604 dated October 31 2018).

Within the framework of the educational program, the objects of study are electrical complexes and systems for generating electrical energy, electric drive, power supply, electrical equipment, electrical technology.

The field of study:

1. Development of the general theory of electrical complexes and systems, the study of system properties and connections, physical, mathematical, simulation and computer modeling of electrical components complexes and systems.
2. Substantiation of a set of technical, technological, economic, environmental and social criteria for evaluating decisions made in the field of design, creation and operation of electrical complexes and systems.
3. Development, structural and parametric synthesis of electrical complexes and systems, their optimization, as well as the development of efficient control algorithms.
4. Investigation of the efficiency and quality of functioning of electrical complexes and systems in various modes, with a variety of external influences.

5. Development of safe and efficient operation, utilization and liquidation of electrical complexes and systems after they have reached their intended resource.

3. Competence model (portrait) of a graduate

3.1 The areas of professional activity

- conducting research and development in the field of heat power engineering and electrical technology, energy use and energy supply in separate sections (stages, tasks) of the topic in accordance with the approved methods;
- development of program plans and test methods, participation in experiments, observations and measurements, drawing up their descriptions and conclusions in the development of modernization and operation of electric power and electrical equipment;
- technical substantiation of the decisions taken on the development of electric power and electrical technology systems;
- development of mathematical and simulation models for the functioning of power and electrical installations and systems;
- analysis of the state and prospects of development of the electric power industry, using the necessary tools and methods;

3.2 Professional activities

scientific (experimental) - research;

- production and technological;
- design and engineering;
- repair and maintenance;
- educational;
- organizational and managerial;
- innovative,
- settlement and design;
- pedagogical.

3.3 General educational competencies

— to have an idea of the role of science and education in public life, of current trends in the development of scientific knowledge, of topical methodological and philosophical problems of the natural sciences;

— know the methodology of scientific knowledge, the principles and structure of the organization of scientific activity;

— possess psychological methods and means of increasing the effectiveness and quality of education;

— know the psychology of cognitive activity of undergraduates in the learning process;

— have the skills to use the knowledge gained for the original development and application of ideas in the context of scientific research;

— be able to critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena.

3.4 Core competencies

— possess the skills of carrying out information and bibliographic work with the involvement of modern information technologies,

— to be fluent in a foreign language at a professional level, which allows for scientific research and teaching of special disciplines in universities,

— be able to summarize the results of research and analytical work in the form of a dissertation, have the skills of research, etc.

— have the skills to carry out educational and pedagogical activities, methods of teaching professional disciplines, the use of modern information technologies in the educational process.

3.5 Professional competencies

- collection, analysis of scientific and technical information, domestic and foreign experience on the research topic;

- development and research of theoretical and experimental models of objects of professional activity in various fields;

- development and study techniques analysis, synthesis, optimization and predicting the quality of the processes of functioning of objects;

- modeling processes and objects on the base standard packages computer-aided design and research;

- setting up and conducting experiments according to a given methodology and analyzing the results;

- analysis of the results of experiments, preparation and drafting of reviews, reports and scientific publications;

- forecasting the development of electric power systems and technologies;

4 The base of practices and employment

Teaching practice Pedagogical practice is carried out during the period of theoretical training without interrupting the educational process, while doctoral students can be involved in conducting classes in undergraduate and graduate programs.

- design pedagogical activities; clearly convey to students the content of the topics of the studied academic discipline; organize the work of the group during classes;

- organize the independent work of students and monitor its results. Possess the basic methodological methods of organizing various types of educational work;

- educational material and content of the taught discipline; methods of organizing students' independent work. Practice objectives: the program of pedagogical practice is aimed at the implementation of theoretical knowledge and improvement of practical skills and abilities of working with a student group.

In the course of passing pedagogical practice, it is necessary: to get acquainted with the tasks, content and features of educational, methodological and educational work at KATU after S. Seifullin;

- to study the real state of the integral pedagogical process of the university;
- study the age characteristics of bachelor students;
- curricula, work programs in the subject of their specialty and other educational and methodological documentation of the department;
- practically master all forms of organization of education at the university, draw up lecture notes, plans for seminars, practical and laboratory classes.

The research practice of a doctoral student is carried out with the aim of studying the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as consolidating practical skills, applying modern methods of scientific research, processing and interpreting experimental data in the dissertation research.

Practice objectives

This type of practice solves the following tasks:

- 1) to form a comprehensive understanding of the specifics of the activities of a scientist in the field of "Power Engineering";

- 2) master methods research, in the greatest degree corresponding to the profile of the specialty "Power Engineering";

- 3) improve skills and skills independent research activities;

- 4) improve personality the future scientific about employee, specializing in the field of Electricity. persons (employers).

The bases of research / industrial practice are organizations corresponding to the profile of the specialty being trained (or related organizations):

- "KazNIIMESH" JSC
- "National Research Institute for Industrial Safety Problems" RSE
- "Akmola electricity distribution company" JSC
- "Astana-REC" JSC
- KokshetauEnergo LLP
- "Tavrida Electric Astana" LLP
- FAMES JSC "KEGOC"
- "KazTekhEnergoexpertiza" LLP
- ARMADA SV LLP
- Energoinform JSC, Astana
- "Astana-Regional Electric Grid Company" JSC, Astana
- "NC" Kazakhstan Temir Zholy " JSC, Astana
- Kazakhstan branch of Karachaganak Petroleum Operating BV

5 The structure of the educational program

No	Names of cycles and disciplines	Total labor intensity	
		in academic hours	in academic credits
1	2	3	4
1.	Educational component	1590	53
1.1	Cycle of basic disciplines (DB)	240	eight
1)	University component		
	Experimental research methods in the electric power industry	150	five
2)	Component of choice		
3)	Teaching practice	90	3
1.2	The cycle of profiling disciplines (PD)	1350	45
1)	University component	450	fifteen
	Electromechanical systems	150	five
	Special issues of electric power complexes and systems	150	five
	Optimization of modes of electric power systems	150	five
2)	Component of choice		
	University component and (or) Optional component		
3)	Research practice	900	thirty
2	Research work	3450	115
1)	Research work of a doctoral student, including an internship and a doctoral dissertation		
3	Additional types of training		
4	final examination	360	12
1)	Writing and defending a doctoral dissertation	360	12
	Total	5400	180

Appendix 3. Description of disciplines of the DB cycle

Basic information about the discipline:	
1. Description of the discipline	Experimental research methods in the electric power industry
2. Number of credits	five
3. Prerequisites:	Mathematical problems and computer modeling in the electric power industry
4. Post-requisites:	<p>Experimental research methods in the electric power industry</p> <ul style="list-style-type: none"> – Mathematical modeling of processes and objects based on standard CAD and research packages. – Carrying out experiments according to a given methodology, drawing up a description of the research being carried out and analyzing the results. – Analysis of the state and dynamics of quality indicators of objects <p>4 activities using the necessary research methods and tools.</p> <ul style="list-style-type: none"> – Creation of mathematical models. ability to plan and set research objectives, choose experimental work methods, interpret and represent research results
5. Competencies:	<p>know:</p> <ul style="list-style-type: none"> – advanced domestic and foreign achievements in areas in electric power and electrical engineering; – main directions, tendencies and prospects of development of objects of electric power and electrical engineering; – methods and funds scientific research in electric power and electrical engineering; <p>be able to:</p> <ul style="list-style-type: none"> – use in-depth theoretical and practical knowledge that is at the forefront of science and technology for the chosen research method; – set research objectives and analyze the results of research in the electric power industry and electrical engineering; <p>own:</p> <ul style="list-style-type: none"> – the main theoretical and experimental methods used in the advanced areas of electric power and electrical engineering.
6. Course author	Tatkeeva G.G.
7. Main literature	<ol style="list-style-type: none"> 1. Voznesensky V.A. Statistical methods for planning an experiment in technical and economic research. M., 1974. 2. V.V. Nalimov Experiment theory. M., 1971. 3. Hartman K., Letsky E., Shefer V. Planning an experiment in the study of technological processes. M.,

	<p>1977. 4. Planning the experiment. Bibl. Pointer. M., 1969, 1972.</p>
<p>8. Contents disciplines</p>	<p>Methods experimental research in electric power industry -The goal of the discipline is to implement level system of higher professional education in training direction 6D071800 - Electricity in parts in-depth professional education, allowing the graduate to work successfully in the chosen sphere of activity, have universal and subject-specialized competencies that contribute to its social mobility and sustainability in the labor market.</p>

Appendix 4. Description of the disciplines of the PD cycle

Basic information about the discipline:	
1. Description of the discipline	Electromechanical systems
2. Number of credits	five
3. Prerequisites:	Transients in the electric power industry, Electrical cars
4. Post-requisites:	Electromechanical systems - must know and be able to use: <ul style="list-style-type: none"> – EMC construction principles; – EMC classification, their models and main characteristics; – methods of analysis and synthesis of EMC; – structural and functional diagrams of controlled electric drives, power and information elements of electric drives; – characteristics of electric drives; – computer facilities and numerical methods for solving problems of analysis and synthesis of EMS
5. Competencies:	<p>know:</p> <ul style="list-style-type: none"> – functional purpose and principles of construction of electromechanical systems, – organization of control in open and closed electromechanical systems, – operating modes of electromechanical systems and principles of constructing closed-loop EMC based on subordinate (multi-loop) regulation; <p>be able to:</p> <ul style="list-style-type: none"> – it is technically competent to choose motors for open-loop and closed-loop systems in various modes of their operation, – to draw up control circuits for DC and AC motors in an open circuit, – choose a structure and be able to calculate closed EMC, built on the principle of single-loop and multi-loop control systems; <p>own:</p> <ul style="list-style-type: none"> – skills constructing electromechanical systems, built on the principle of single-circuit and multi-circuit regulation systems.
6. Course author	Isenov S.S.
7. Main literature	<ol style="list-style-type: none"> 1. Domrachev, Yu.S. Smirnov. Digital-to-analog positioning systems. M., Energoatomizdat, 1990. 2. Volkov, V.P. Milovzorov. Electromachine automation devices. Textbook for universities. M., High School, 1986. 3. Akhmetzhanov, A.V. Kochemasov. Tracking systems and regulators. Textbook for universities. M., Energoatomizdat, 1986.

	four. Sabinin. Electromachine devices automation. Textbook for universities. M., Energoatomizdat, 1988.
8. Content of the discipline	Electromechanical systems - refers to general technical disciplines and serves to form knowledge and skills in areas of basic methods of construction, operation and development of electromechanical devices and their main component, creation base for studying others general technical and special disciplines.

Basic information about the discipline:	
1. Description of the discipline	Special issues of electric power complexes and systems
2. Number of credits	five
3. Prerequisites:	Electrical networks and systems, Electrical machines
4. Post-requisites:	Special issues of electric power complexes and systems - doctoral students receive knowledge on the preparation and formulation of a problem, – applied software for calculating parameters and selecting devices for electrical and electrical power equipment – design features of electric power and electrical installations for various purposes – manufacturing technology of the main elements of boilers and steam generators;
5. Competencies:	Know: – applied software for the calculation of parameters and the selection of electrical and power engineering devices equipment; – design features of electric power and electrical installations for various purposes; – features of professional operation of modern equipment and devices; – methods and means of automated control systems for technological processes in the electric power and electrical industry; Be able to: – use in-depth knowledge in the field of natural sciences and humanities in professional activities (PC-1); – use the elements of economic analysis in the organization and conduct of practical activities at the enterprise; – develop plans and programs for organizing innovative activities at the enterprise; – present research results in the form of reports, abstracts, scientific publications and at public discussions (PC-41). Own:

	<p>– terminology in the field of automated control systems technological processes electric power and electrical industry;</p> <p>– the skills of using the information obtained in the design of automated control systems for technological processes in the electric power and electrical industry.</p>
6. Course author	Utegulov B.B.
7. Main literature	<p>1. Gustav O., Djanguido P. Digital automation and control systems. - SPB .: Nevsky Dialect, 2001 .-- 57 p.</p> <p>2. Automation of dispatch control in the electric power industry / Ed. and. - M .: Ed. MPEI, 2000 .-- 648 p.</p> <p>3. Shershevsky of Siemens telemechanics systems in power engineering // Automation and IT in the energy sector, 2009, No. 1, p. 4-9.</p>
8. Content of the discipline	<p>Special issues of electric power complexes and systems - is the study of the issues of automation of the technological process, accounting, control and dispatch control in electric power systems, using electronic computers, to understand the basic principles and rules for constructing automated systems in electric power systems; to study and understand the structure and device of the equipment used in construction of ACS E, ASDU and ASKUE systems.</p>

Basic information about the discipline:	
1. Description of the discipline	Optimization of modes of electric power systems
2. Number of credits	five
3. Prerequisites:	Diagnostics, modeling and control electric power systems
4. Post-requisites:	<p>Optimization of modes of electric power systems - know:</p> <ul style="list-style-type: none"> – general information about electric power systems and their modes, rational management of the power system; – criteria and methods for the optimal distribution of power in the electric power system; – methods optimization modes, intricately closed heterogeneous electrical networks. <p>be able to:</p> <ul style="list-style-type: none"> - determine the optimal distribution of active capacities by the method of relative increments; - determine losses and relative gains in losses in networks; perform power distribution in the power system based on analytical optimization methods; - calculate the economic distribution of capacity in a closed network; - choose innovative ways to optimize the operating modes of electrical networks.

5. Competencies:	<ul style="list-style-type: none"> – readiness to operate, test and repair technological equipment of the electric power and electrical industry – the ability to make decisions in the field of electric power and electrical engineering, taking into account energy and resource conservation; – the ability to determine effective production and technological modes of operation of electric power facilities and electrical engineering.
6. Course author	Akhmetbaev D.S.
7. Main literature	<ol style="list-style-type: none"> 1. Venikov V.A. and other Optimization of modes of power plants and power systems: Textbook for universities / V.A. Venikov, V.G. Zhuravlev, T.A. Phillipova - M.: Energoatomizdat, 1990 - 352 p., Ill. 2. Arzamastsev D.A. and other ACS and optimization of power systems modes. Training manual. for university students. / Arzamastsev D.A., Bartolomey P.I., Kholyan A.M. Ed. Arzamastseva D.A. - M.: Higher school, 1983 - 208 p., Ill. 3. Electrical systems. Electrical calculations, programming and optimization modes. Ed. V.A. Venikov. Study guide for electric power. universities. - M.: Higher school, 1973 - 320 p. ill.
8. Content of the discipline	<p>Optimization of modes of electrical power systems - Acquisition of knowledge in the field of optimization of modes of electrical power systems and main electrical networks on the basis of special mathematical methods and computing tools.</p> <p>The main tasks of the discipline include teaching the principles of the most profitable distribution of capacities between generating sources, determining the total losses and relative increments of losses through the nodal capacities, optimizing the modes of complex-closed heterogeneous networks.</p>