Institute Energy and Mechanical engineering
Department "Power Engineering"

EDUCATIONAL PROGRAM

8D07112 –Electrical power engineering

Code and classification of the field of education: **8D07 Engineering, manufacturing and construction industries**

Code and classification of training directions: **8D071 Engineering and Engineering affairs**

Group of educational programs: **D099 Energy and electrical engineering**

Level based on NQF: **8**

Level based on IQF: **8**

Study period: **3 year**

Amount of credits: **180 ECTS**

Almaty 2024

The educational program 8D07112 – "Electrical Power engineering" was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes # 12 dated 22.04. 2024.

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council

Minutes # 6 dated 19.04.2024.

Educational program 8D07112 – "Electrical Power engineering" was developed by Academic committee based on direction "Engineering and Engineering"

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List of abbreviations and designations

EP – educational program
BC – basic competencies
PC – professional competencies
LO – learning outcomes
MOOC – massive open online courses
NQF – National Qualifications Framework
IQF – Industry Qualifications Framework

1. Description of educational program

The educational program for training a Doctor of Philosophy (PhD) has a scientific and pedagogical focus and involves fundamental educational, methodological and research training and in-depth study of disciplines in the relevant areas of science for the system of higher and postgraduate education and the scientific sphere.

The educational program for training a doctor in the profile involves fundamental educational, methodological and research training and in-depth study of disciplines in the relevant areas of science for the branches of the national economy, social sphere: education, medicine, law, art, economics, business administration and in the field of national security and military affairs.

Educational programs for doctoral studies in terms of professional training are developed based on a study of the experience of foreign universities and research centers implementing accredited programs for training PhD doctors or doctors in the profile.

The content of the educational program for specialized doctoral studies is established by the university independently. The main criterion for completion of the educational process for training Doctors of Philosophy (PhD) (doctor in the profile) is the acquisition by the doctoral student of at least 180 academic credits, including all types of educational and scientific activities. The term of study in doctoral studies is determined by the volume of academic credits acquired.

Upon acquisition of the established volume of academic credits and achievement of the expected learning outcomes for obtaining the degree of Doctor of Philosophy (PhD) or in the profile, the educational program of doctoral studies is considered fully mastered. Training of personnel in doctoral studies is carried out on the basis of educational programs of the master's degree in two areas: 1) scientific and pedagogical with a term of study of at least three years; 2) specialized with a term of study of at least three years.

The professional activity of graduates of the program covers the field of electric power engineering, electric power networks and systems, power supply, relay protection and automation of power systems, electromechanics and renewable energy.

The direction of the program of specialty and specializations relates to engineering and engineering. In case of successful completion of the full course of study for a doctorate, defense and approval of a scientific dissertation by the Ministry of Education and Science of the Republic of Kazakhstan, the graduate is awarded the degree of Doctor of Philosophy.

The educational program provides for the study of the following innovative disciplines:

- methods of designing electric power and electrical engineering complexes;
- modern and promising electric drive control systems;
- finite element method and CAD in electrical engineering;
- microprocessor control systems for technological processes in the power industry;

- energy and resource saving technology by means of an electric drive.

In the process of mastering the educational program, the graduate must acquire the following key competencies:

- has skills in oratory and public speaking at international scientific forums, conferences and seminars;
- perfectly knows a foreign language for scientific communication and international cooperation;
- is able to use mathematical methods of thinking (logic, spatial thinking) and presentations (formulas, models, tables, etc.) in their professional activities.
- has skills in conducting patent searches and experience in transmitting scientific information using modern information and innovative technologies;
- has an idea of the main stages of development and paradigm shifts in the evolution of science, scientific schools in the relevant field of knowledge, their theoretical and practical developments, the mechanism for implementing scientific developments in practical activities, and pedagogical and scientific ethics;
- knows how to organize, plan and implement the process of scientific research, analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions, conduct independent scientific research characterized by academic integrity, based on modern theories and methods of analysis;
- knows how to generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge, select and effectively use modern research methodology, plan and forecast their further professional development;
- has the skills of critical analysis, evaluation and comparison of various scientific theories and ideas, planning and forecasting research results;
- demonstrate the quality and effectiveness of the selected scientific methods, participation in scientific events, fundamental scientific domestic and international projects; - is competent in the field of scientific and scientific-pedagogical activity in the context of rapid renewal and growth of information flows, in conducting theoretical and experimental scientific research;
- is competent in matters of university training of specialists, in conducting examination of scientific projects and research;
- is able to take responsibility, jointly develop a solution and participate in its implementation;
- knows how to prevent and resolve conflicts, find compromises, correlate their opinion with the opinion of the team;
- has skills in leadership management and team management, a responsible and creative attitude to scientific and scientific-pedagogical activity;
- has an idea of the norms of interaction in the scientific community, is competent in matters of interpersonal communication and human resources management;
- has the basics of economic knowledge, has scientific ideas about management, marketing, finance, etc., knows and understands the goals and methods of state regulation of the economy;

- knows how to generate ideas and predict the results of innovative activities, knows how to think creatively and creatively approach solving new problems and situations; has the skills to critically analyze, evaluate and compare various scientific theories and ideas.

The educational program "Electrical Engineering and Power Engineering" provides training for specialists in the following types of activities:

Types of work activities of graduates of the doctoral program in electrical engineering and power engineering must have competencies in accordance with the types of professional activities:

in the field of production and technological activities:

- be the head of the energy department for the operation, maintenance, repair and adjustment of various enterprises;

in the field of organizational and managerial activities:

- be the head of a scientific department dealing with problems of electrical engineering and power engineering, a university department, a department for the operation, maintenance and repair of energy complexes and systems;

in the field of experimental research activities:

- be the head of a scientific laboratory for conducting theoretical and experimental studies of energy facilities, systems and devices;

in the field of research and pedagogical activities:

- be a leading research fellow or head of a scientific laboratory for the research and development of electrical systems and installations in various industries; - be a teacher of undergraduate, graduate and doctoral subjects in specialized disciplines in the field of electrical engineering, power engineering;

in the field of design and engineering activities:

- be the head of a department for the development and design of electrical and energy facilities in various industries.

Types of work activity

The model of a graduate in the educational program "Electrical Engineering and Power Engineering" has the following competencies:

have an idea of:

- the main stages of development and paradigm shifts in the evolution of science; the subject, ideological and methodological specifics of natural (social, humanitarian, economic) sciences;

- scientific schools of the relevant field of knowledge, their theoretical and practical developments;

- scientific concepts of world and Kazakhstani science in the relevant field;

- the mechanism for implementing scientific developments in practical activities;

- the norms of interaction in the scientific community;

- the pedagogical and scientific ethics of a research scientist.

know and understand:

- modern trends, directions and patterns of development of domestic science in the context of globalization and internationalization;

- methodology of scientific knowledge;

- achievements of world and Kazakhstani science in the relevant field;
- (realize and accept) the social responsibility of science and education;
- perfect foreign language for scientific communication and international cooperation;

be able to:

- organize, plan and implement the process of scientific research; analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;
- analyze and process information from various sources;
- conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;
- generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- choose and effectively use modern research methodology;
- plan and forecast their further professional development.

have the skills of:

- critical analysis, evaluation and comparison of various scientific theories and ideas;
- analytical and experimental scientific activity;
- planning and forecasting research results;
- oratory and public speaking at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
- planning, coordination and implementation of scientific research processes;
- systematic understanding of the field of study and demonstrating the quality and effectiveness of the selected scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership management and team management;
- responsible and creative attitude to scientific and scientific-pedagogical activity;
- conducting patent search and experience of transferring scientific information using modern information and innovative technologies;
- protection of intellectual property rights to scientific discoveries and developments;
- free communication in a foreign language.

be competent:

- in the field of scientific and scientific-pedagogical activity in the context of rapid renewal and growth of information flows;
- in conducting theoretical and experimental scientific research;
- in setting and solving theoretical and applied problems in scientific research;
- in conducting professional and comprehensive analysis of problems in the relevant field;
- in matters of interpersonal communication and human resource management;

- in matters of university training of specialists;
- in conducting examination of scientific projects and research;
- in ensuring continuous professional growth.

Objects of professional activity:

Graduates of this specialty can make a career:

- in research organizations;
- in the design and engineering field of activity;
- in organizations of higher and secondary technical education, for training undergraduate, graduate and doctoral students in special disciplines;
- in national, transnational energy companies and industrial enterprises.

The training includes research practice at such enterprises as: NK KEGOC, JSC AZhK, JSC AlES, JSC Kazatomprom, Karachaganak Petroleum Operating and others.

Research internships at the Braunschweig University of Technology (Germany), the Technical University of Dresden (Germany), the University of Applied Sciences Zittau/Gorlitz (Germany), Tomsk Polytechnic University (Russia), Peter the Great St. Petersburg Polytechnic University (Russia) are also provided.

2. Purpose and objectives of educational program

Purpose of EP: The aim of the educational program "Electric Power Engineering" is to train doctoral students in basic and specialized disciplines, prepare and defend a dissertation in the field of electric power engineering with the achievement of relevant competencies.

Tasks of EP: theoretical and practical training of highly qualified doctoral students capable of performing tasks in the field of electric power engineering using modern scientific technologies and techniques.

3. Requirements for evaluating the educational program learning outcomes

Persons with a master's degree and at least 1 (one) year of work experience or who have completed residency training are admitted to doctoral studies.

Admission to doctoral students is carried out by the admissions committees of universities and research organizations based on the results of the entrance examination for groups of educational programs of doctoral studies and a certificate confirming proficiency in a foreign language in accordance with the common European competencies (standards) of proficiency in a foreign language.

When enrolling in universities, doctoral students independently choose an educational program from the corresponding group of educational programs.

Enrollment of persons for targeted training of doctors of philosophy (PhD) under the state educational order is carried out on a competitive basis.

The procedure for admitting citizens to doctoral studies is established in

accordance with the "Model rules for admission to study in educational organizations implementing educational programs of postgraduate education."

At the "entrance" the doctoral student must have all the prerequisites necessary for mastering the corresponding professional educational program of doctoral studies. The list of required prerequisites is determined by the higher education institution independently.

In the absence of the required prerequisites, the doctoral candidate is allowed to master them on a fee-paying basis. In this case, doctoral studies begin after the doctoral candidate has fully mastered the prerequisites.

Admission to the university is carried out upon applications from an applicant who has fully completed the course of the scientific and pedagogical master's degree in the program "Electrical Engineering and Power Engineering" in accordance with the points of the certificate issued based on the results of testing at the Republican Testing Center in English, as well as passing an oral exam in special subjects. Special requirements for admission to the program apply to graduates of the specialized master's degree in the program "Electrical Engineering and Power Engineering", as well as master's degrees in related educational programs: automation and control, thermal power engineering.

Requirements for completing the training and obtaining a diploma

Persons who have mastered the educational program of doctoral studies and defended a doctoral dissertation, subject to a positive decision of the dissertation councils of the higher education institution with a special status or the Committee for Control in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan based on the results of the examination, are awarded the degree of Doctor of Philosophy (PhD) or doctor in the profile and are issued a state diploma with an appendix (transcript).

Persons who have received the degree of PhD, in order to deepen their scientific knowledge, solve scientific and applied problems on a specialized topic, perform a postdoctoral program or conduct scientific research under the supervision of a leading scientist selected by the higher education institution.

3.1 Requirements for key competencies of doctoral graduates:

1) have an idea of:

- the main stages of development and paradigm shifts in the evolution of science;
- the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences;
- scientific schools of the relevant field of knowledge, their theoretical and practical developments;
- scientific concepts of world and Kazakhstani science in the relevant field;
- the mechanism for implementing scientific developments in practical activities;
- the norms of interaction in the scientific community;

- the pedagogical and scientific ethics of a research scientist;

2) know and understand:

- modern trends, directions and patterns of development of domestic science in the context of globalization and internationalization;

- the methodology of scientific knowledge; – achievements of world and Kazakhstani science in the relevant field;

– (to be aware of and accept) the social responsibility of science and education;

– to be fluent in a foreign language for scientific communication and international cooperation;

3) to be able to:

– organize, plan and implement the process of scientific research;

– analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;

– analyze and process information from various sources;

– conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;

– generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;

– choose and effectively use modern research methodology;

– plan and forecast their further professional development;

4) have the skills of:

- critical analysis, evaluation and comparison of various scientific theories and ideas;

- analytical and experimental scientific activity;

- planning and forecasting research results;

- public speaking and public speaking at international scientific forums, conferences and seminars;

- scientific writing and scientific communication;

- planning, coordination and implementation of scientific research processes;

- systematic understanding of the field of study and demonstrating the quality and effectiveness of the selected scientific methods;

- participation in scientific events, fundamental scientific domestic and international projects;

- leadership management and team management;

- responsible and creative attitude to scientific and scientific-pedagogical activity;

- conducting patent searches and experience in transferring scientific information using modern information and innovative technologies;

- protection of intellectual property rights to scientific discoveries and developments; – free communication in a foreign language;

5) be competent:

– in the field of scientific and scientific-pedagogical activity in the context of rapid renewal and growth of information flows;

– in conducting theoretical and experimental scientific research;

– in setting and solving theoretical and applied problems in scientific research;

– in conducting a professional and comprehensive analysis of problems in the relevant field;

– in matters of interpersonal communication and human resource management;

– in matters of university training of specialists;

– in conducting an examination of scientific projects and research;

– in ensuring continuous professional growth.

3.2 Requirements for research work of a student in the Doctor of Philosophy (PhD) program:

1) compliance with the main issues of the doctoral educational program, on which the doctoral dissertation is defended;

2) relevant and contains scientific novelty and practical significance;

3) based on modern theoretical, methodological and technological achievements of science and practice;

4) based on modern methods of processing and interpreting data using computer technologies;

5) performed using modern methods of scientific research;

6) contains research (methodological, practical) sections on the main provisions being defended.

3.3 Requirements for the organization of internships:

The internship is conducted with the aim of developing practical skills in scientific, scientific-pedagogical and professional activities.

The educational program of doctoral studies includes:

1) pedagogical and research internship - for students in the Doctor of Philosophy program; 2) industrial practice - for students in the specialized doctoral program.

During the period of pedagogical practice, doctoral students, if necessary, are involved in conducting classes in the bachelor's and master's programs.

Research practice of a doctoral student is carried out with the purpose 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 dissertation research.

Industrial practice of a doctoral student is carried out with the purpose of consolidating theoretical knowledge obtained during the training process and improving the professional level.

The content of research and industrial practices is determined by the topic of the doctoral dissertation.

Generally mandatory standard requirements for completing doctoral studies and awarding a PhD degree: mastering at least 110 academic credits of theoretical training and preparation for passing the state exam in the specialty and defending the dissertation. Requirements for key competencies of doctoral graduates:

A graduate should know:

- modern trends, directions and patterns of development of domestic science

in the context of globalization and internationalization;

- methodology of scientific knowledge;
- achievements of world and Kazakhstani science in the field of electric power industry, electrical networks and systems;
- understand and accept the social responsibility of science and education;
- perfect foreign language for scientific communication and international cooperation.

be able to:

- organize, plan and implement the process of scientific research;
- analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;
- conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;
- conduct research activities in the field of electrical networks and electric power systems;
- draw up reports and proposals for improving the maintenance of electrical equipment of electrical networks and systems;
- plan and forecast their further professional development.

have skills in:

- analytical and experimental scientific activity;

planning and forecasting research results;

- oratory and public speaking at international scientific forums, conferences and seminars.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	**8D07 Engineering, manufacturing and construction industries**
2	Code and classification of training directions	**8D071 Engineering and Engineering affairs**
3	Educational program group	**D099 Energy and electrical engineering**
4	Educational program name	**8D07112 –Electrical power engineering**
5	Short description of educational program	The educational program for training a Doctor of Philosophy (PhD) has a scientific and pedagogical focus and involves fundamental educational, methodological and research training and in-depth study of disciplines in the relevant areas of science for the system of higher and postgraduate education and the scientific sphere. The content of the educational program of specialized doctoral studies is established by the University independently. The main criterion for the completion of the educational process for training Doctors of Philosophy (PhD) (doctor in the profile) is the mastering by the doctoral student of at least 180 academic credits, including all types of educational and scientific activities.

		The duration of study in doctoral studies is determined by the volume of academic credits mastered.
6	Purpose of EP	Training of personnel focused on scientific, experimental research and teaching activities in the electric power industry and management of technological systems
7	Type of EP	New OP
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	no
11	List of competencies of educational program	PC 1: main legislative and regulatory documents of the Republic of Kazakhstan on energy saving, technical and organizational issues of installation, adjustment and operation of electrical installations of industrial enterprises, fundamentals of the theory of transient processes occurring in the power system and the power supply system both during normal operation (switching on and off loads, power sources, individual circuits, etc.) and in emergency situations (short circuit, open circuit of the loaded circuit or its individual phase, loss of synchronism of the synchronous machine, etc.); PC 2: methods of minimizing conductive electromagnetic interference in electric power systems, ensuring electromagnetic compatibility of technical equipment, perform calculations of operating and post-emergency modes of power supply circuits of industrial enterprises; PC 3: normal, emergency and special modes of operation of electrical equipment; methods of eliminating abnormal modes and actions of operating personnel in the event of disruptions in the operation of the main and auxiliary equipment of the EPS; the design and operation of the main electrical equipment of stations and substations, fundamentals of the theory of electrical apparatus; PC 4: Physical principles of electromechanical and electrical energy conversion, structure and operating principle of AC and DC electric drives, basic information about electrical receivers and power sources of an industrial enterprise; determine estimated electrical loads and select standard electrical equipment; Basic principles of selecting heat-mechanical equipment; Methods of distributing electrical energy across an enterprise with a voltage of 6-10 kV; PC 5: Structure and operating principle of modern power semiconductor elements; Structure and operating principle of semiconductor converters used in an electric drive; PC 6: - select power electrical equipment and control circuits for electrical installations in accordance with environmental conditions, calculate regulated levels of electromagnetic compatibility based on steady-state voltage deviation, voltage curve sinusoidality distortion coefficient, and temporary switching overvoltage coefficient; PC 7: Select filter-compensating units and non-linear surge limiters, place them in general and local power supply

		systems, check the admissibility of connecting generators for parallel operation using precision synchronization and self-synchronization methods; evaluate the success of self-starting of electric motors; PC 8: analyze the electrical connection diagrams of the switchgear under various operating modes, conduct tests and take and calculate the characteristics of DC machines, asynchronous motors and synchronous machines; PC 9: determine the adjustment properties of electric motors of various types, determine the calculated electrical loads and select standard electrical equipment; perform calculations of operating and post-emergency modes of power supply circuits of industrial enterprises; PC 10: analyze the processes of electricity metering; perform technical and economic calculations for the selection of power supply circuits and the main and auxiliary equipment; calculate and select the main elements of the circuits of power conversion devices; PC 11: perform a preliminary calculation of the parameters and select a serial converter for a specific application; describe and explain, based on individual legislative and regulatory acts, the state policy on the efficient use of energy resources in the Republic of Kazakhstan. PC 12: on the selection, installation, adjustment and operation of electrical installations of industrial enterprises; - principles of converting electrical circuits of power supply systems; on solving problems in electromagnetic compatibility; On issues of electromagnetic compatibility in the electric power industry; PC 13: On constructing power diagrams and compiling a map of permissible generator loads; Calculating technical characteristics and parameters of electrical equipment, selecting optimal circuit solutions when designing electrical stations and substations; Testing electrical installations and experimentally determining their characteristics; Testing and maintenance of electrical installations; Repair and adjustment of electrical installations. PC 14: Methods for calculating the stability, quality and reliability of electrical systems; Methods for calculating electrical loads at the input of consumers; The latest achievements of digital technology for the protection and automation of power system elements; Using methods for analyzing power supply systems; Using modern computational design tools; Using and analyzing the application of resource-saving technologies in organizing construction production.
12	Learning outcomes of educational program	LO1 - demonstrate the ability to apply the acquired knowledge to analyze and synthesize control systems for electric power and electrical engineering facilities using modeling methods; LO2 - study and have skills in the effective operation of microprocessor control systems in electric power and electrical engineering complexes in

		specific conditions; LO3 - demonstrate the ability to understand alternative energy sources and renewable energy resources and power plants based on them, and be able to compare their efficiency in specific conditions; LO4 - apply the basic principles, methods and rules for constructing intelligent control systems in the electric power industry; LO5 - analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions, process information from various sources; LO6 - be proficient in energy and resource saving technologies in the operation of electric drives and electrical networks; LO7 - apply scientific and mathematical principles of applied electrical engineering and electromechanics; LO8 – select modern and promising technical means of automation of electric power and electrical engineering complexes, freely read various control schemes of electric power and electrical engineering complexes and demonstrate skills in debugging them; LO9 – demonstrate the ability to master and apply analytical and numerical methods of theories of electrical contacts and devices; LO10 – use methods of critical analysis and evaluation of modern scientific achievements, methods of generating new ideas in solving research and practical problems, methods of scientific research activities.
13	Education form	Daytime
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Russian
17	Academic degree awarded	"Ph.D"
18	Developer(s) and authors	Sarsenbaev E.A., Khidolda E.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)									
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10
Cycle of basic disciplines University component													
M-1	Academic writing	Objective: To develop academic writing skills and writing strategies in doctoral students in engineering and natural sciences. Content: Fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, conclusion, references; in-text citations; preventing plagiarism, as well as writing a conference presentation.	5					V					
M-1	Methods of scientific research	Objective: to acquire knowledge of the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometrics. Contents: the structure of technical sciences, the application of general scientific, philosophical and special methods of scientific research, principles of organizing scientific research, methodological features of modern science, ways of developing science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice.	5					V					
Cycle of basic disciplines Component of choice													
M-2	Theory of electrical apparatus	This discipline provides basic ideas about the fundamentals of the theory of electrical apparatus as a single electromechanical complex, including current-carrying elements, contacts, insulating structures, arc-extinguishing devices, drive devices and electromagnetic mechanisms. Mathematical descriptions of the physical processes accompanying the operation of electrical apparatus during operation	5										

		are given. Doctoral students receive ideas on all issues of this discipline, study the main processes occurring in electrical apparatus. In the process of studying the discipline, doctoral students must understand the mathematical descriptions of the physical processes accompanying the operation of electrical apparatus during operation.										
M-2	Intelligent systems in the electric power industry	The purpose of studying the course is to develop clear knowledge in doctoral students on the theory and practice of intelligent power systems, which is a mandatory component of training a highly qualified specialist. The objectives of the course are to master the basic provisions of the theory and practice of intelligent power systems. As a result of studying, the doctoral student should have an idea of all issues of this discipline, know the methodological foundations of scientific knowledge and creativity, the theory and practice of intelligent power systems.	5		v							
M-2	Sustainability Science	Objective: To develop in doctoral students a deep understanding of the interactions between natural and social systems, as well as to develop skills in identifying and developing strategies for sustainable development that contribute to the long-term well-being of humanity and the preservation of the environment. Content: The complex relationships between ecosystems and societies, as well as to delve into the analysis of problems	5			v						
Cycle of profile disciplines Component of choice												
M-2	Modern and advanced electric drive control systems	General information and qualification of electric drive control systems, concept of electric drive coordinates. Function and tasks of electric drive control systems. Classification features of electric drive control systems, relay-contactor electric drive control systems, purpose and tasks of relay-contactor systems. Electrical circuits and methods for analyzing relay-contactor systems. Control principles and typical units of relay-contactor systems. Examples of implementation of relay-contactor systems. General characteristics and synthesis of discrete logical electric drive control systems. Mathematical	5						v			

		foundations for designing discrete logical electric drive control systems. Transition and output functions. Cyclogram method. Construction of discrete logical systems based on digital units.										
M-2	Energy and resource saving technology using electric drives	The purpose of studying the discipline "Technology of energy and resource saving by means of electric drive" is to acquire knowledge by doctoral students on the problem of energy saving at industrial enterprises. Knowledge of ways to save electricity by rational construction of electric drives of production machines and mechanisms for various purposes, as well as familiarization of doctoral students with technical solutions for electrical equipment included in electric drives, ensuring high productivity and efficiency of the technological process of production.	5	v								
M-2	Alternative energy sources	Providing doctoral students with knowledge in the field of one of the sections of modern science – alternative energy. Mastering by doctoral students the theoretical foundations and understanding of physical phenomena underlying alternative energy. Preparing doctoral students for scientific activities related to issues of development and research in the field of alternative energy sources. Acquiring skills in independently solving research problems in the field of alternative energy sources.	5						v			
M-2	Finite Element Method and CAD in Electrical Engineering	The aim of the discipline is to study and master the basic methods of three-dimensional modeling and numerical solution of finite element methods of applied and scientific problems of electric power engineering. The objectives of studying the discipline are: studying the scientific foundations of building modern electric power and electrical engineering complexes, principles and methods of implementing optimal technical solutions in their design.	5					v				

5. Curriculum of educational program

NJSC "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATPAYEV"

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board
Rector of KazNRTU named after K.I. Satbayev
M.M. Begentayev
" " 2024

CURRICULUM
of Educational Program on enrollment for 2024-2025 academic year

Educational program 8D07112 - "Electrical power engineering"
Group of educational programs D099 - "Power engineering and electrical

Form of study: full-time | Duration of study: 3 year | Academic degree: Doctor of Philosophy (PhD)

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and					
								1 course		2 course			
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
MET322	Scientific research methods	BD UC	5	150	2/0/1	105	E	5					
LNG305	Academic writing	BD UC	5	150	0/0/3	105	E	5					
component of choice													
ERG301	Theory of electrical apparatus	BD CCH	5	150	2/1/0	105	E	5					
ERG302	Intellectual systems in power industry				2/0/1								
MNG350	Sustainability Science												
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of design studies in the field of electric power engineering (component of choice)													
ERG304	Modern and advanced electric drive control systems	PD CCH	5	150	2/1/0	105	E	5					
ERG305	Energy and resource saving technology by means of electric drive				2/0/1	105							
ERG308	Alternative sources of energy	PD CCH	5	150	2/0/1	105	E	5					
ERG309	Finite element method and CAD in electrical engineering												
M-3. Practice-oriented module													
AAP350	Pedagogical practice	BD UC	10						10				
AAP355	Research practice	PD UC	10							10			
M-4. Experimental research module													
AAP336	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	5					5					
AAP347	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	40						20	20			
AAP356	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	60								30	30	
AAP348	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	18										18
M-5. Module of final attestation													
ECA303	Writing and defending a doctoral dissertation	FA	12										12
	Total based on UNIVERSITY:							30	30	30	30	30	30

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
			university component (UC)	component of choice (CCH)	Total
BD	Cycle of basic disciplines		20	5	25
PD	Cycle of profile disciplines		10	10	20
	Total for theoretical training:	*0*	*30*	*15*	*45*
	RWDS				*123*
FA	Final attestation	12			12
	TOTAL:	12	30	15	180

Decision of the Academic Council of Kaznru named after K.Satpayev. Protocol № 12 "25" 04 2024.

Decision of the Educational and Methodological Council of Kaznru named after K.Satpayev. Protocol № 6 "18" 09 2024.

Decision of the Academic Council of the InstituteInstitute of Energy and Mechanical Engineering. Protocol № 4 "18" 09 2024y.

Vice-Rector for Academic Affairs — R.K. Uskenbayeva

Director Institute of Energy and Mechanical Engineering — K.K.Yelemessov

Department Head «Power Engineering» — Ye.A. Sarsenbayev

Specialty Council representative — G.E. Abdykalykov

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of mastering the additional educational programs (Minor)