MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

NON-PROFIT JOINT STOCK COMPANY

« ALMATY UNIVERSITYOF ENERGY AND COMMUNICATIONS NAMED AFTER GUMARBEK DAUKEEV»

Energo University
after Gumarbek Daukeyev

INSTITUTE OF ELECTRIC POWER ENGINEERING AND ELECTRICAL ENGINEERING

«Agreed»

General Director of the Sh.Ch. Chokin
Kazakh Research Institute of
Electrophysics
K.A. Bakenov
«___» _____2026 y.

«Approved»

Rector of AUES
Nygymetov G.S.
«___» _____2026 y.

MODULAR EDUCATIONAL PROGRAM
7M07116 ELECTRIC POWER SYSTEMS

(MASTER'S PROGRAM IN SCIENCE AND PEDAGOGY)

POSTGRADUATE EDUCATION

Field of Study: 7M071 Engineering and Engineering Activities
Group of educational programs: M099 Electric Power Engineering

Duration of Study 2 years
Degree Awarded: Master of Engineering Science
Qualification Level according to the National Qualifications Framework: Level 7

Almaty 2026 y.

The Modular Educational Program (MEP) 7M07116 – Electric Power Systems is developed based on the State Compulsory Standard of Higher Education (Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018, No. 604, Appendix 8), the National Qualifications Framework (approved by the protocol of the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations on March 16, 2016), the Sectoral Qualifications Framework "Energy", and draft professional standards.

The MEP was developed at the departments: « Electric Power Engineering »
Head of the educational program: Kaliyeva K.Z. – Assoc.Prof. of the EPS Department, PhD.
The following participated in the discussion of the MEP:
Turlybekov A.K. - Commercial Director of JSC KazNIPIITES "Energy";
Adilbekov N.K. - Deputy Chief Engineer of JSC "AJK".

The MEP was reviewed and approved at a meeting of the EE Department. № 10 dated 19.05. 2026y.

Head of the Department of EPS _____ Uteshkalieva L.Sh..

The MEP was approved at a meeting of the educational and methodological commission of the Institute of Energy and Green Technologies. Protocol №6 dated 21.05. 2026y.

Director of IEZT _____ E.T. Amitov

The MEP was reviewed and approved by the Academic Council of the Almaty University of Energy and Communications named after Gumarbek Daukeev (protocol №12 dated 28.05 2 26y.).

Contents

Passport of the educational program

№	Field Name	Note
1	Registration Number	
2	Code and Classification of the Field of Education	7M07 Engineering, Processing, and Construction Industries
3	Code and Classification of the Fields of Study	7M071 Engineering and Engineering Practice
4	Group of Educational Programs	M099 Energy and Electrical Engineering
5	Name of the Educational Program	7M07116 Electric Power Systems (Scientific and Pedagogical Master's Program)
6	Type of Educational Program	Active Educational Program
7	Goal of the Educational Program	Training of highly qualified scientific and pedagogical personnel in the generation, transmission, and distribution of electric power, possessing theoretical and practical knowledge, skills, and abilities to conduct research and impart knowledge to students, capable of independent thinking and contributing to the progressive scientific, technological, socio-economic, and cultural development of society.
8	ISCED Level	7
9	NQF Level	7
10	SQF Level	7
11	Distinctive Features of the Educational Program	none
	Partner University (Additional Educational Program)	none
12	List of Competencies	The learning outcomes of the Educational Program 7M07116 – "Electric Power Systems" are expressed through competencies in accordance with the National and Sectoral Qualifications Frameworks, professional standards, and aligned with the Dublin Descriptors and the European Qualifications Framework. Graduates are expected to possess the following competencies: 1)Demonstrate advanced knowledge and understanding acquired at the higher education level, which forms the basis or opportunity for original development or application of ideas, often in the context of research; 2)Apply knowledge, understanding, and problem-solving skills in new or unfamiliar situations within broader (or interdisciplinary) contexts related to the field of study; 3)Integrate knowledge, manage complexity, and make judgments based on incomplete or limited information, taking into account ethical and social responsibility for the application of these judgments and knowledge. 4)Communicate clearly and effectively their conclusions and knowledge, along with the underlying rationale, to both specialists and non-specialists; 5)Continue learning independently and engage in self-directed professional development.

		Requirements for the key competencies of graduates of the Scientific and Pedagogical Master's Program: Key Competencies **KKN1** (Research Competencies) – the graduate should: - Have an understanding of the role of science and education in society, current trends in the development of scientific knowledge, and the relevant methodological and philosophical issues in the natural (social, humanitarian, economic) sciences; - Know the methodology of scientific inquiry, as well as the principles and structure of organizing research activities; - Be able to: apply acquired knowledge to conduct scientific research; analyze existing concepts, theories, and approaches to the study of processes and phenomena; integrate knowledge from different disciplines to solve research problems in new and unfamiliar conditions; think creatively and approach new problems and situations innovatively; possess professional-level proficiency in a foreign language; summarize the results of research and analytical work in the form of a dissertation, scientific article, report, etc.; - Possess the following skills: conducting research activities; solving standard scientific problems; using modern information technologies in the educational process; professional communication and intercultural interaction; public speaking; correctly and logically presenting ideas in both oral and written form; expanding and deepening knowledge necessary for everyday professional activities and for continuing education at the doctoral level; - Be competent in the methodology of scientific research, as well as in methods for continuously updating knowledge and expanding professional skills and abilities. Key Competencies **KKN2** (Pedagogical Competencies): - Have an understanding of the professional competencies of a higher education instructor, as well as the contradictions and socio-economic consequences of globalization processes; - Know the psychology of students' cognitive activity during the learning process, as well as psychological methods and tools for enhancing the effectiveness and quality of education; - Be able to: apply knowledge of higher education pedagogy and psychology in teaching activities; use interactive teaching methods; carry out information-analytical and information-bibliographic work using modern information technologies, enabling the conduct of scientific research and the teaching of specialized disciplines at universities; - Possess the following skills**:** carrying out educational and pedagogical activities using the credit-based learning system; applying methods for teaching professional disciplines; - Be competent in scientific and scientific-pedagogical activities at higher education institutions, in the use of modern educational technologies, and in conducting scientific projects and research within the professional field. Requirements for the special competencies of graduates of the Scientific and Pedagogical Master's Program: Special Competencies **SCN1** (Design, Calculation, and Production-Technological Competencies) – the graduate should: - Have an understanding of the development and implementation of advanced technologies for the design and operation of electrical equipment, as well as measures to extend the service life of electrical equipment, prevent accidents

		and occupational injuries, reduce labor intensity and maintenance costs, and improve maintenance quality. - Know how to carry out modernization work and improve the reliability of electric power systems and their equipment; - Be able to: integrate professional knowledge with practical experience; create new applied knowledge in the field of electric power engineering and/or at the intersection with other specialties; identify sources and search for information necessary to improve professional activities. - Possess the following skills: participating in project work; performing necessary calculations using computer software; testing and commissioning electrical equipment; preparing reports in accordance with the forms established by current regulatory documents; - Be competent in reviewing rationalization proposals and inventions, providing evaluations for them, and ensuring the implementation of accepted proposals. Special Competencies **SCN2** (Organizational and Managerial Competencies) – the graduate should: - Have an understanding of the organization of activities for improving the qualifications and professional skills of workers and foremen, training them in secondary and related professions, and conducting educational and motivational work within the team; - Know how to organize teams (including their quantitative, professional, and qualification composition), develop and implement measures for the efficient management of teams, and coordinate their activities; -: Be able to: analyze the results of production activities; monitor labor cost expenditures; ensure the accuracy and timeliness of primary documentation for tracking working hours, output, and downtime; - Be competent in ensuring the safe and reliable operation of all types of electrical equipment, their proper use, and timely, high-quality maintenance and technical servicing.
13	Learning Outcomes	**LO-1**. Will be able to effectively use modern computer and information technologies, digital equipment, and software to solve scientific and technical problems in electric power engineering. Will possess skills in modeling elements of electric power systems and working with computer programs such as Rastr Win, PS CAD, and MatLab. **LO-2.** Able to improve and develop their intellectual level based on knowledge of the philosophy of science, higher education pedagogy, foreign languages, and management psychology. Capable of independently acquiring new knowledge and skills and expanding their scientific worldview. **LO-3.** Will demonstrate theoretical and practical knowledge in the field of modern diagnostics and testing of power equipment, improving the reliability and quality of electric power, as well as in issues of electromagnetic compatibility in electric power engineering. **LO-4.** Will possess knowledge of integrated digital automatic control systems in electric power systems and electric drives, skills in programming, diagnostics, and adjustment of variable-frequency drives, and the ability to conduct research on modern electric drives using the MATLAB Simulink software environment. **LO-5.** Will be able to demonstrate knowledge of calculating operating modes of power plants and electrical networks, as well as methods for reducing losses. Will be able to perform calculations of transmission line elements and

		have an understanding of overvoltage protection, modern relay protection, and emergency automation systems. **LO-6.** Will demonstrate skills in managing projects related to the implementation of measures and methods for ensuring the stability of electric power systems, the modernization of power plant equipment and electrical networks, their automatic control, and efficient operation. **LO-7.** Able to develop measures for energy and resource conservation and for the implementation of renewable energy sources in both autonomous and grid-connected modes. Capable of adapting new energy-saving technologies and energy storage systems at existing power facilities and enterprises in other sectors of the economy. **LO-8**. Able to demonstrate knowledge of scientific management of energy enterprises, skills in forecasting electricity consumption and power demand, developing and implementing sections of innovation strategy, performing techno-economic analysis of project solutions, and using computer-aided design systems and applied software in scientific and engineering-technical design calculations. **LO-9.** Will be able to independently analyze scientific and technical problems of electric power systems, access and evaluate scientific information in international networks, plan and conduct scientific experiments, and process and present the results of research. **LO-10.** Will be able to conduct teaching and scientific research at an appropriate methodological level, deliver classroom lessons, and prepare and present master's theses and scientific projects. .
14	Form of Study	Full-time
15	Language of Instruction	Russian, Kazakh
16	Credit Load	120
17	Degree Awarded	Master of Technical Sciences
18	Availability of an Appendix to the License for the Field of Study	Perpetual State License for Educational Activities KZ 80LAA00018161 dated 05.05.2020 y.
19	Accreditation Status of the Educational Program	Accredited
	Name of the Accreditation Body	IAAR
	Accreditation Validity Period	04.2030 y.
20	Information on Courses	Information on the Core/Compulsory, Basic, and Elective Courses is provided in Appendix 1.
21	Field of Professional Activity	The field of professional activity – electric power engineering, as a part of the energy sector, encompasses the set of tools, methods, and techniques of human activity for the generation, long-distance transmission, distribution, and consumption of electric energy.
22	Types of Professional Activity	A specialist for work in research universities, scientific research and design institutes, higher education institutions, and enterprises (generating, transmitting, distributing, and consuming electric energy), capable of performing the following types of professional activities:

		-Design and engineering; -Production and technological; -Organizational and managerial; -Scientific and pedagogical.
23	Modular Curriculum	Presented in Appendix 2

2. The matrix of correlation of learning outcomes in the educational program as a whole with the competencies being formed

№		ON1	ON2	ON3	ON4	ON5	ON6	ON7	ON8	ON9	ON10
1	History and philosophy of science		v								
	Foreign language (professional)		v								
3	Higher school pedagogy		v								
4			v								
5											v
6	Methods of scientific research and organization of experiments									v	
7	Electromagnetic compatibility in the electric power industry			v							
8	Modeling of elements of electric power systems in the Matlab environment	v			v						
9	Theory of modeling and scientific experiment									v	
10	Diagnostics and professional testing of electrical equipment			v							
1	Modern methods for assessing the insulation condition of electrical equipment			v							
2	Scientific and technical problems of electric power systems									v	
3	Electricity losses in electric networks					v					
4											v
5	Emergency response operational and automatic control of electric power systems					v					
6	Electricity quality in the electric power industry			v							
17	Energy storage in electric power systems							v			
8	Mechanical characteristics and calculation of elements of power transmission lines					v					
9	Special modes of long-range power transmission					v					
20	Methods of reliability analysis and assessment in the electric power industry			v							
1	Theory and practice of project management								v		

2	Organization and management of public procurement								v		
3								v			
4	Optimization of own needs of electric power plants					v					
5	Operating modes of synchronous generators of electric stations					v					
26	Energy saving in electric drives of electric stations				v						
27	Relay protection of distribution power grids and surge limitation					v					
28	Means and methods of ensuring the stability of electrical systems						v				
29	The main problems of operation of electrical networks and systems	v									
30	Scientific foundations of energy management								v		

1. Structure of the Modular Educational Program of Postgraduate Education (Scientific and Pedagogical Master's Program)

The list of courses in the university component and elective component is determined independently by the university. In doing so, labor market needs, employer expectations, and the needs and interests of master's students are taken into account. The university component of the basic cycle (BC) in all Scientific and Pedagogical Master's Programs, in accordance with the State Compulsory Higher Education Standard (GOSO), includes the following courses: "History and Philosophy of Science," "Foreign Language (Professional)," "Higher Education Pedagogy," and "Management Psychology."

In the Scientific and Pedagogical Master's Program, the basic cycle (BC) accounts for 29% of the total volume of the master's educational program, or 35 academic credits. Of these, 57%, or 20 academic credits, are allocated to the core (compulsory) courses.

In the Scientific and Pedagogical Master's Program, the elective cycle (EC) accounts for 41%, or 49 academic credits, of the total volume of the master's educational program.

Requirements of the State Compulsory Postgraduate Education Standard and the structure of the postgraduate educational program (Scientific and Pedagogical Master's Program). It contains all the necessary components, including the university and elective components.

The modular program meets the minimum credit requirements with 108 credits for theoretical training and 12 credits for the final assessment (10%).

The timing and types of internships in the educational program are defined as follows: Pedagogical Practice – 3rd semester (4 credits). Research Practice – 2nd semester (4 credits). Research Practice – 4th semester (7 credits).

The elective component is defined in the catalog of elective courses.

2. Catalog of Elective Courses

The Catalog of Elective Courses (CEC) is formed for the entire period of study, taking into account possible changes in accordance with industry needs, the preferences of student groups (at least one subgroup), faculty academic exchanges, and the opportunity to attend modern professional courses taught by leading specialists and researchers from renowned universities worldwide. The CEC is developed and issued as a separate document and is made available on the university's website.

3. Modular Study Plan

The methodological basis of modular learning is grounded in the principles, methodology, and procedures for developing the Modular Educational Program (MEP). The effectiveness of learning outcomes is achieved through a comprehensive approach, in which the educational programs, study plans, and courses are all structured according to the modular principle. The content and volume of each module vary depending on the didactic objectives, the specialization and level differentiation of students, and the entire educational program is structured into autonomous organizational and methodological modules.

The formation and content of the modules provide the necessary degree of flexibility and freedom for students in choosing their learning path and acquiring specialized professional competencies, thereby enhancing their competitiveness in the labor market.

The Modular Study Plan is presented in Appendix 2.

- Module MEE H02 is compulsory.
- Module MEE H01 is compulsory–elective.
- Module MEE H03 is elective.

These modules provide the opportunity to select courses from the elective component in order to acquire specific professional competencies. For example, in Module MEE H01 – "Fundamentals of Scientific Research," a student may choose either "Theory of Modeling and Scientific Experiment" or "Fundamentals of Modeling and Data Processing in Scientific and Engineering Experiments", thereby mastering competencies in an experiment-oriented course depending on a focus on experimental techniques or, more broadly, on types and forms of scientific research. In Module MEE H03 – "Scientific and Technical Problems of Electric Power Engineering," a student may choose either "Diagnostics and Professional Testing of Electrical Equipment" or "Modern Methods for Assessing the Condition of Electrical Equipment Insulation", thereby mastering specialized competencies oriented toward production-technological activities in the context of scientific and technical progress, which is characteristic of the electric power industry. Special competencies specific to the chosen specialization are reinforced through the study of Modules MEE H04-1 or MEE H04-2, which are elective modules. One of these four modules must be studied in accordance with the selected specialization (educational trajectory).

The acquisition of special competencies, teamwork skills, the ability to work in production environments, independently solve assigned tasks, and pedagogical skills is facilitated through the study of Modules MEE H02 and MEE H06. In Module MEE H06, significant attention is given to research activities from the perspective of professional competencies. The variety of experimental research forms conducted in production and in the laboratories of the Autonomous Electric Power Systems (specialized Technical and Scientific Laboratories) – including testing, commissioning, and operational studies – allows the master's student to prepare materials for the master's thesis.

4. Procedure for Selecting the Learning Track

The modules of the educational program follow both a "horizontal-vertical" and a "horizontal" structure. Each module consists of a core (compulsory) and an elective component. The learning outcomes after completing a module may vary depending on the chosen elective component of the module. The elective part allows for flexibility in adjusting the learning path up to the selection of specialization modules MEE H04-1 or MEE H04-2.

This scheme of forming the Modular Educational Program (MEP) provides the master's student with freedom in selecting courses listed in the Catalog of Elective Courses and the basic study plan, allows each student to personally participate in shaping their individual study plan, and involves academic advisors in the learning process to assist master's students in choosing their educational path.

As a result of implementing the chosen educational path, the student should acquire the required competencies. The Individual Educational Path (IEP) consists of university (compulsory), elective, corrective, and organizational components. The compulsory component includes the main modules required for study, which correspond to the structure of the Modular Educational Program (MEP) of postgraduate education. The elective component consists of a set of modules and their constituent parts, which the master's student selects for study according to their areas of interest. Both the compulsory and elective components are aimed at determining the content of learning. lready in the first year of study, the master's student selects a specialization and, within the elective component of the Modular Educational Program (MEP), chooses a specialization module, which is compulsory for study. The corrective component provides assistance to students in selecting courses within the elective parts of modules and elective modules, taking into account their individual characteristics, as well as in determining the organizational component. The organizational component includes the following elements of the system: forms, methods, technologies, tools, and assessment of the study of the selected content. Table 4.1 presents the organizational components of the Individual Educational Path (IEP).

Table 4.1 Organizational components of the Individual Educational Path (IEP).

Elements of Asynchronous Learning	Ensuring Asynchronous Learning	Tools Ensuring Asynchronous Learning
1.Independent work of the master's student 2.Selection of courses within the elective component 3.Selection of an additional training profile within the framework of academic exchange and research internships	Office of Doctoral and Master's Programs	Working Study Plan Class Schedule Schedule of Faculty Consultations for Independent Study (SRS) Monitoring the Implementation of the Study Plan
	Departments, Academic Advisors, Tutors	Individual Study Plan of the Master's Student
	Faculty	TMCD, schedule of completion and submission of assignments, list of recommended literature
	Master's Students	Library, electronic editions, Internet, syllabuses

Table 4.2 presents the content component of the IEP. The content component specifies the options for forming the individual educational technology. Within the educational program, it is possible to implement academic mobility, obtain additional education (an additional set of courses (credits)), and receive a second degree at a partner university.

Table 4.2 content component of the IEP.

Options of the IEP	Ensuring Asynchronous Learning	Tools Ensuring Asynchronous Learning
Individual Set of Competencies	Tutors, Master's Students	Individual Study Plan of the Master's Student
	Departments, Academic Supervisors	Set of Elective Courses, Individual Work Plan of the Master's Student
	Office of Doctoral and Master's Programs	Working Study Plan
Specification of the Training Profile (RGR, CR, Research Work)	Tutors, Master's Students	Individual Study Plan of the Master's Student
	Departments, Academic Supervisors	Approximate Topics of CR, Topics of RGR, Topics of EIRM
Individual Level of Mastery of Courses (High, Medium, Low)	Master's Students, Academic Supervisors	Regulations on the Point-Rating Assessment System, Schedule for Completing Assignments, Experimental and Research Work, Internship
Professional Adaptation to Professional Activity During Internships	Master's Students, Departments, Academic Supervisors, Office of Doctoral and Master's Programs (ODMP)	Internship Programs, Agreements with Enterprises on Internship Bases, Formation of Individual Internship Assignments
Extended Set of Professional Competencies (Selection of an Additional Training Profile)	Academic Supervisors, Master's Students	Individual Work Plan of the Master's Student
	Office of Doctoral and Master's Programs (ODMP), Master's Students, Academic Supervisors, International Department of AEPS	Non-linear Schedule, Main Educational Program of the Additional Training Profile, Professional Advanced Training Courses, Internships, List of Courses (Credits) within the SCO University, List of Credits within Academic Mobility

The study of basic and specialized cycles of the elective component by the master's student is carried out in accordance with the chosen field of study. When selecting elective courses, the topic of the master's thesis and the advice of the academic supervisor are taken into account. The specific training direction of the future specialist is determined through the study of elective modules: MEE H04-1 "Electric Networks and Systems" and MEE H04-2 "Electric Power Plants". The study of these modules is mandatory when selecting the training direction (specialization). In the fourth semester, preparation for the final assessment is conducted, the research internship is carried out, and tasks related to the

specific content of the thesis are addressed during the research internship. After selecting courses, master's students will complete 30 credits in the first, second, and third semesters. The following components must be completed: Pedagogical and Research Internship, Research Work, and Final Assessment.

The volume of credits completed by modules and courses of study is presented in the summary Table 4.3.

The educational program offers great opportunities; by forming additional modules in the cycle of specialized disciplines within the elective part of the program, it is possible to train specialists in a wide range of specializations, keeping pace with the times.

Table 4.3 Summary Table Reflecting the Volume of Credits Completed by Modules of the Educational Program

Course of Study	Semester	Number of Modules to Be Completed	Number of Courses		Number of Credits (KZ)						Total (in hours)	ECTS	Quantity	
			BK	KB	Theoretical Training	Pedagogical	Industrial Practice	Research Work	Final Assessment	Total			Exam	Differentiated Credit
1	1	4	5	3	29	0	0	1	0	30	900	30	7	1
	2	3	-	5	25	4	0	1	0	30	900	30	5	2
2	3	2	-	3	15	0	4	11	0	30	900	30	4	2
	4	3	-	-	0	0	7	11	12	30	900	30	КЭ	2
Total			5	11	69	4	11	24	12	120	3600	120	16+КЭ	7

ПРИЛОЖЕНИЯ

Приложение 1
к государственному общеобязательному
стандарту послевузовского образования

Структура образовательной программы магистратуры по научно-педагогическому направлению

№ п/п	Наименование циклов дисциплин и видов деятельности	Общая трудоемкость	
		в академических часах	в академических кредитах
1	*2*	*3*	*4*
1.	Теоретическое обучение	1920	64
1.1	Цикл базовых дисциплин (БД)	1050	35
1)	Вузовский компонент (ВК):	600	20
	в том числе:		
	История и философия науки		
	Иностранный язык (профессиональный) Педагогика высшей школы		
	Психология управления Педагогическая практика		
2)	Компонент по выбору (КВ)	450	15
1.2	Цикл профилирующих дисциплин (ПД)	1470	49
1) 2)	Вузовский компонент (ВК) Компонент по выбору (КВ)		
3)	Исследовательская практика		
2	Научно-исследовательская работа	720	24
1)	Научно-исследовательская работа магистранта, включая прохождение стажировки и выполнение магистерской диссертации (НИРМ)	720	24
3	Дополнительные виды обучения (ДВО)		
4	Итоговая аттестация (ИА)	360	12
1)	Оформление и защита магистерской диссертации (ОиЗМД)	360	12
	Итого	3600	120

Appendix 3

Table P3.1 Information on Studied Courses and Competencies Developed

№	Course Title	Brief Description of the Course (30–50 words)	Number of Credits	Developed Competencies (Codes)
Basic Disciplines Cycle				
University Component				
1	History and Philosophy of Science	As a result of studying the course, master's students are able to apply methodological techniques and knowledge in conducting research, pedagogical and educational work, and to analyze and comprehend the realities of modern theory and practice based on the history and philosophy of science.	3	KKH1, KKH2
2	Foreign Language (Professional)	Acquisition of language knowledge in professional activities. Working with texts from textbooks and other sources of scientific, technical, business, socio-political, and general nature. Structural composition, main elements, and stylistic features of typical written texts and documents. Development of communicative skills in monologic and dialogic oral speech. Typical lexical-grammatical constructions and main techniques for structured public speaking.	5	KKH1, KKH2
3	Higher Education Pedagogy	To reveal the main methodological principles of educational science, its key patterns and principles within the processes of teaching and upbringing in higher education, including didactics, systemic, activity-based, technological, and learner-centered approaches as the methodology of pedagogy, as well as the methods, problems, and prospects of its development.	5	KKH2
4	Management Psychology	Development of students' professional reflection in the field of psychology, whose effectiveness depends on a scientific approach, psychological competence, and skillful use of psychological resources. Thus, the need to develop psychological and pedagogical competence of specialists in the new conditions of social development determines the relevance of this course in the system of higher professional education. To stimulate the development of interest in practical psychological activities.	3	KKH2, CKH2
5	Pedagogical practice	The pedagogical practice of master's students is carried out within the framework of the overall concept of master's training. The main goal of the practice is the development of technological skills related to pedagogical activities. It contributes to the process of socialization of the master's personality and prepares them for pedagogical work at the university.	4	KKH2
		Total University Component of the Basic Cycle (BC)	**20**	
Basic Disciplines Cycle				
Elective Component				
	Elective Course 1 (choose 1 out of 2)		5	

1	Methods of Scientific Research and Experiment Organization	Forms of knowledge and research methods in the fields of natural and technical sciences are studied. The systems approach is examined in detail as an important methodology for organizing experiments. The most common quantitative and qualitative methods for data processing and interpretation of results are described, as well as methods for experimentally determining the static and dynamic relationships between the variables of the research object. Various algorithms for solving optimization problems are also considered.		CKH1
	Electromagnetic Compatibility in Electric Power Engineering	General patterns of electromagnetic compatibility, electromechanical energy conversion, the structure and characteristics of various electric drive systems, and the operating modes of drives for different purposes are considered. Methods for analyzing physical phenomena in technical devices and systems are examined, along with the main tools of computer technology and information technologies, and the fundamental concepts and laws of electrical engineering and electromagnetic phenomena.		CKH1
	Elective Course 1 (choose 1 out of 2)		5	
2	Modeling of Electric Power System Components in MATLAB Environment	Formation of knowledge in the field of electric power engineering, providing the necessary skills for developing mathematical models of the studied electrical installations and conducting the required research for master's theses. Study and familiarization with the MATLAB software package and its applications SIMULINK and SIMPOWERSYSTEMS. Creation of working models in the SIMULINK environment, editing of circuits and component properties of the models.		CKH1
	Theory of Modeling and Scientific Experiment	A range of issues related to computer modeling of electrophysical processes in power networks and systems is studied. The foundations for classical algorithms for processing arrays of numerical experimental data are provided by the sciences of mathematical statistics and probability theory. Tasks include modern programming of models that simulate reliable real-world experiments and the study of scientific and technical problems in the field of electric power engineering.		CKH1
	Elective Course 3 (choose 1 out of 2)		5	
3	Diagnostics and Professional Testing of Electrical Equipment	Diagnosis of the Insulation Condition of Electrical Equipment. Key indicators of insulation quality and factors affecting changes in their characteristics. Thermal, mechanical, and electrical loads acting on the insulation of electrical equipment. Reliability of electrical insulation materials. Methods of preventive testing. Assessment of the insulation condition of electric machines and power transformers. High-voltage insulation testing.		CKH1
	Modern methods for assessing the condition of electrical equipment insulation	Wear and Aging of Electrical Equipment Insulation. Influence of insulation moisture on the aging process and on electrical resistance. Dependence of the insulation resistance of electric machines on temperature. Assessment of power transformer insulation based on gas chromatographic analysis of oil samples. Acoustic method for monitoring the quality of insulators. Methods of monitoring without disconnecting electrical equipment. Visual tools for detecting defects. High-voltage AC and DC test installations for insulation monitoring.		CKH1

		Total Elective Component of the Basic Cycle (BC)	**15**	
		Total of the Basic Cycle (BC)	**35**	
Specialized Courses Cycle				
University Component				
1	Scientific and technical problems of electric power systems	Study of the technology of electricity generation and examination of issues related to the increasing demand for electricity and the depletion of fuel for conventional power plants. Consideration of modern ways to address problems that have arisen in electric power systems and familiarization with international experience in their resolution. Review of the main causes of problems in the electric power industry, their impact on the environment and the economy, and identification of possible practical solutions.	3	KKH1, KKH2, CKH1, CKH2
2	Electricity losses in power networks	The main causes of electricity losses in power networks are considered, and their structure is described. Examples of the main methods for calculating various components of technological electricity losses in power networks of different voltage classes are provided, along with measures to reduce them. The principles of standardizing electricity losses are presented.	4	CKH1
3	Research practice	The main goal of the graduate student's research practice is to study the theoretical, methodological, and technological achievements of domestic and foreign science, as well as to consolidate practical skills in applying modern methods of scientific research, processing, and interpreting experimental data in dissertation research.	11	KKH1
		Total university component of the curriculum	**18**	
Elective Component				
	Elective course PD 1 (choose 1 out of 2)		**4**	
1	Emergency operational and automatic control of electric power systems	The fundamentals of emergency automation are presented, which ensure the measurement and processing of power system operating parameters, monitoring the status of electrical network elements and generators, and transmitting information and control commands to counter the territorial spread of catastrophic emergency processes. Within its own power unit, power district, or power association, emergency automation addresses all tasks of emergency control.		KKH1
2	Power quality in electric power systems	Formation of stable knowledge on issues of electricity saving and the rational design and operation of power supply systems, as well as power supply quality. The main indicators of power quality and their permissible values. Power quality monitoring. The impact of power quality on electromagnetic compatibility. Statistical assessment of power quality indicators. Methods and tools for improving voltage quality in industrial power networks.		KKH1
Elective component				
	Elective PD course 1 (choose 1 of 2)		**3**	

1	Energy storage systems in electric power systems	Existing and prospective energy storage systems are considered, and criteria for their selection are provided. Main attention is given to the physical processes in storage systems, the features of their characteristics and mathematical models, as well as the comparison of different types of storage systems. The principles of technical implementation of energy storage systems are presented, and rational areas of their application are examined.		CKH1
2	Mechanical characteristics and calculation of transmission line elements	Formation of knowledge in the analysis of mechanical characteristics and the calculation of transmission line elements, which include conductors and ground wires, supports, insulators, line fittings, etc. Mastery of methods for calculating mechanical loads on transmission line elements. Selection of transmission line components (supports, insulators, fittings, etc.), calculation of transmission line elements for mechanical strength, placement of supports along the route profile, calculation of crossings over engineering structures (above-ground pipelines, roads, water bodies, etc.), and calculation of assembly sag of conductors and ground wires.		CKH1
		Elective component		
	Elective PD course 1 (choose 1 of 2)		**3**	
1	Special operating modes of long-distance power transmission	Study of issues related to the transmission of electricity at ultra-high voltage (UHV) over long distances. Development of an equivalent circuit and determination of the parameters of UHV power networks. Main equations and methods for specifying initial data. Analysis and calculations of normal and emergency operating modes. Increasing the transmission capacity of UHV transmission lines.		CKH1, CKH2
2	Methods of analysis and reliability assessment in electric power systems	Mastery of knowledge on the main principles, methods, and technical means for the efficient use of electricity and the reduction of energy losses in the power supply system of an industrial enterprise, as well as ensuring the supply of electricity to consumers with regulated quality, reliability, and cost-effectiveness.		CKH1, CKH2
	Elective PD course 1 (choose 1 of 2)		**5**	
1	Theory and practice of project management	Development of project management skills in the electric power industry, acquisition of teamwork and public speaking skills. Study of a project as a system, including its external and internal environment. Classification of projects and advanced forms of project management. Investigation of investment opportunities in the electric power sector. Project analysis. Project cost assessment. Comprehensive project audit and its information support. Specifics of project management and directions of project activity in the electric power industry.		KKH1
2	Organization and management of public procurement	Will master the principles of public procurement, conditions for ensuring transparency, integrity, and efficiency, the public procurement mechanism, procurement legislation, tender documentation, features of technical specifications, international experience, and new tools in public procurement; procurement in the quasi-state sector, various information services; and the system for preventing corruption risks in public procurement in the Republic of Kazakhstan. Will acquire methods for conducting applied research in the field of public procurement.		KKH1

Trajectory (specialization) – Power Plants				
4.1	Alternative sources of electricity	Energy potential of Kazakhstan. Reserves of energy resources. Trends in the development of large-scale alternative electricity sources. Renewable energy sources, tidal energy, nuclear power, and hydroelectric power plants. Problems and opportunities in the use of alternative electricity sources in Kazakhstan. Gas-turbine and combined-cycle units at thermal power plants.	5	CKH1
4.2	Optimization of the own needs of power stations	Current state and development prospects of the auxiliary power needs (APN) of thermal power plants. Composition, technical characteristics, and operating modes of APN electrical receivers of thermal, nuclear, and hydroelectric power plants. Overview of methods for assessing the safety of APN equipment. Methodology for collecting and processing data from the operation of electrical equipment. Determination of the optimal frequency of preventive restorations of the system. Determination of the optimal frequency of diagnostics. Formation of control actions. Management of diagnostics and maintenance of the APN system.	5	KKH1, CKH1
4.3	Operating modes of synchronous generators of power stations	Familiarization with the purpose and design of synchronous generators of power plants. The main parameters of a synchronous generator: terminal voltage, load current, apparent power, rotor speed, and power factor. Study of the most important generator characteristics: no-load operation, external and excitation characteristics, static and dynamic stability during parallel operation and within the power system. Operating modes of the synchronous machine as a synchronous compensator. Abnormal operating modes of turbo generators.	5	CKH1
4.4	Energy saving in electric drives of power stations	Study of electric drive systems used in the most energy-intensive auxiliary mechanisms of power plants, including feed, circulation, condensate, dredger, and network pump units, car dumpers, and other mechanisms. Determination of effective circuit solutions, control algorithms, and laws for electric drives. Research on modern electric drives is conducted using the MATLAB Simulink software package.	5	KKH1, CKH2
		Elective component of PD	**20**	
Trajectory (specialization) – Electric Networks and Systems				
4.1	Relay protection of distribution power networks and overvoltage limitation	The course covers the fundamentals of relay protection against ground faults: neutral configurations of 6–35 kV power networks, the physical principles of capacitive current compensation, general protection principles, features of current distribution during ground faults, relay protection algorithms, equipment, devices, and protection systems used in practice. Information is provided on overvoltages occurring in networks, which in most cases are the primary cause of ground faults: sources and types of overvoltages, methods, and electrical engineering means of limiting them.	5	KKH1
4.2	Means and methods for ensuring the stability of electric power system operation	The course covers the main issues of the theory and practical methods for performing stability calculations of power systems and load nodes. Key measures to improve stability are presented, along with their classification. Additional automation tools and devices for enhancing stability are examined. The applicability of mathematical stability theory in electric power engineering is discussed. The use of specialized software tools for stability calculations of electric power system operation is also considered.	5	CKH1, CKH2

4.3	Main problems in the operation of electric networks and systems	Familiarization with the issues related to the operation of electric networks and systems at all hierarchical levels of power system management, principles of calculation, design, and operation of their electrical equipment, as well as the acquisition of skills in dispatch control of energy facilities and dispatcher actions in emergency situations.	5	KKH1, CKH1, CKH2
4.4	Scientific foundations of energy association management	Study of the principles of controlling open-loop and closed-loop systems, the use of adaptive models in the control of power system operating modes, and the concept of creating intelligent electrical grids. Acquisition of knowledge in the theory of power system operating mode control, mathematical modeling of power system control processes under normal and emergency conditions, and issues of automation and management of power system operating modes. Methods and algorithms for power network state assessment, stability evaluation, and emergency control calculation; methods and algorithms for techno-economic justification in the development and implementation of technological and system automation.	5	KKH1, CKH2
		Elective component of PD	**20**	
		Total PD	**38**	

Appendix 4

P4.1 Structure and content of the modular educational program. Description of modules (competency matrix).

The methodological foundation of modular learning is based on the principles, methods, and procedures for developing modular educational programs.

The effectiveness of learning outcomes is achieved through a comprehensive approach, where both the educational programs, curricula, and courses are structured according to the modular principle.

The content and scope of each module vary depending on the didactic objectives, as well as the profile and level differentiation of the students, and the entire educational program is structured into autonomous organizational and methodological modules. Table P4.1 presents the list of modules and the competencies formed as a result of studying the modules.

The formation and content of modules provide the necessary degree of flexibility and freedom for students in choosing their learning trajectory and acquiring specialized professional competencies, enhancing competitiveness in the labor market.

A systematic approach to building the structure of the educational program, a specific course, and their content is expressed through strict adherence to logical sequence, coordination of module study, and ensuring interdisciplinary and inter-module connections. Modules generally follow a “horizontal-vertical” scheme, while in the second semester, a “horizontal” scheme is applied for choosing the profile direction of study. Modules consist of mandatory and elective components. Learning outcomes after completing a module may vary depending on the chosen elective component of the module. The elective part allows for adjustments to the learning trajectory.

The modules of the educational program represent logically interconnected disciplines and are focused on achieving a specific learning outcome, that is, competence (Table P4.1). They allow varying the depth and direction of learning, responding promptly to the needs of students, employers, and the labor market. In the interdisciplinary approach implemented in the educational program, courses and even individual sections and topics within them are considered as parts of certain levels of the hierarchy of professional training. Each level of the hierarchy may contain a number of interdisciplinary modules, which are individual in terms of academic and scientific knowledge in the specialty and are united by a single requirement for the level of the formed learning outcome in accordance with the three-level psychological-professional hierarchy: general science training modules are combined based on the predominant formation of the analytical-synthetic level – professional training; modules where the final result is the formation of general engineering skills and knowledge – algorithmic level; modules where the completion is specialized disciplines – creative-intellectual level.

The correlation of learning outcomes with the disciplines studied within the framework of the educational program 7M07101 and information about the studied disciplines are presented in Appendix P4.1.

Table P4.1 – Modular Educational Program “Electric Power Systems” (Master’s Program in Scientific and Pedagogical Training)

Module code	Module title	List of courses (component type)	Learning outcomes	Competencies	Form of final assessment
МЭЭ Н01	Fundamentals of Scientific Research	*University component*			
		History and Philosophy of Science	PO-2	ККН1, ККН2	Exam
		Scientific and Technical Problems of Electric Power Engineering	PO-8	ККН1, ККН2, СКН1, СКН2	Exam
		Electric Energy Losses in Power Networks	PO-5	СКН1	Exam
		Elective Component			
		Project Management Theory and Practice	PO-8	СКН1, СКН2	Exam
		Organization and Management of Public Procurement	PO-8	СКН1, СКН2	Exam
		Research Methods and Experimental Design	PO-1, PO-9	ККН1	Exam
		Electromagnetic Compatibility in Power Engineering	PO-3	ККН1	Exam
		Elective Component			
		Modeling of Power System Components in Matlab Environment	PO-1	СКН1, СКН2	Exam
		Theory of Modeling and Scientific Experimentation	PO-9	СКН1, СКН2	Exam
МЭЭ Н02	Pedagogical and Language Training	*University Component*			
		Foreign Language (Professional)	PO-2	ККН1, ККН2, СКН2	Exam
		Management Psychology	PO-2	ККН2, СКН2	Exam
		Higher Education Pedagogy	PO-2, PO-10	ККН2	Exam
МЭЭ Н03	Technological Problems of Electric Power Systems	*Elective Component*			
		Diagnostics and Acceptance Testing of Electrical Equipment	PO-3	СКН1	Exam
		Modern Methods for Assessing the Insulation Condition of Electrical Equipment	PO-3	СКН1	Exam
		Elective Component			
		Power Quality in Electric Power Engineering	PO-3	СКН1	Exam
		Emergency Operational and Automatic Control of Electric Power Systems	PO-5	СКН1	Exam
		Elective Component			
		Energy Storage Systems in Electric Power Systems	PO-7	ККН1, СКН1, СКН2	Exam
		Mechanical Characteristics and Calculation of Power Transmission Line Components	PO-5	ККН1, СКН1, СКН2	Exam
		Elective Component			
		Special Modes of Long-Distance Power Transmission	PO-5	СКН1, СКН2	Exam

Module code	Module title	List of courses (component type)	Learning outcomes	Competencies	Form of final assessment
		"Methods for Analysis and Reliability Assessment in Power Engineering	PO-5	CKH1, CKH2	Exam
МЭЭ-Н04-02	Electric networks and systems	Relay Protection of Distribution Power Networks and Overvoltage Limitation	PO-5	CKH1	Exam
		Means and Methods for Ensuring the Stability of Electric Power System Operation	PO-5	CKH1, CKH2	Exam
		Main Problems in the Operation of Electric Networks and Systems	PO-6	KKH1, CKH1, CKH2	Exam
		Scientific Foundations of Energy Association Management	PO-8	KKH1, CKH2	Exam
МЭЭ-Н04-01	Electric power stations	Alternative Sources of Electricity	PO-7	CKH1	Exam
		Optimization of Power Plants' Own Needs	PO-6	CKH1, CKH2	Exam
		Operating Modes of Synchronous Generators of Power Plants	PO-5	CKH1, CKH2	Exam
		Energy Saving in Electric Drives of Power Plants	PO-7	KKH1, CKH2	Exam
МЭЭ-Н5 ПП	Professional practice	Pedagogical practice	PO-10	KKH2	(report) d
		Research practice	PO-2, PO-9	KKH1, CKH1	(report) d
		Scientific research work, including the completion of a master's thesis	PO-9, PO-10	KKH1	(report) d
НИРМ	Master's student research work	Comprehensive examination. Preparation and defense of the master's thesis	PO-10	KKH1, KKH2, CKH1, CKH2	State exam, defense of a master's thesis
ИА	Final certification				

The implementation of the competency-based approach involves extensive use of active and interactive forms of instruction (seminars in a dialogue mode, discussions, computer simulations, business and role-playing games, analysis of specific situations, psychological and other trainings, group discussions, results of research group work, university and inter-university teleconferences) in combination with extracurricular activities (independent work, professional practice, internships) in order to form and develop the professional skills of students. One of the main active forms of training in professional competencies related to the type(s) of activity for which the master is being prepared (design and project work, production and technological, organizational and managerial) in the master's program is the scientific-technical seminar, conducted on a regular basis throughout theoretical training with the involvement of leading researchers and practitioner specialists, serving as the basis for adjusting the individual study plans of the master. Within the framework of the courses, meetings with representatives of energy companies, government and public organizations, and expert and specialist master classes are provided.

Appendix 5

P5. Documents Regulating the Requirements for Graduate Competencies

P5.1 Laws and Regulatory Documents for the Development of the Educational Program

The educational program is developed based on the laws of the Republic of Kazakhstan and regulatory documents: State Compulsory Educational Standards (Order of the Ministry of Education and Science of the Republic of Kazakhstan dated October 31, 2018, № 604, Appendix 8); Rules for Organizing the Educational Process Using the Credit-Based Learning Technology (Order of the Ministry of Education and Science of the Republic of Kazakhstan dated April 20, 2011, № 152), which regulate the requirements for graduates awarded the degree of Master of Technical Sciences in the educational program 7M07117 – Electric Power Systems.

P5.2 Regulatory Documents Governing the Requirements for Graduate Competencies

National Classifier of Occupations of the Republic of Kazakhstan (NCO)
NCO RK 01-2017.

1. Classifier of fields of training for higher and postgraduate education. Approved by Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 13, 2018, № 569.
2. National Qualifications Framework. Approved by the protocol of March 16, 2016, of the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations.
3. Sectoral Qualifications Framework "Energy." Approved by the Protocol of the Sectoral Commission on Social Partnership and Regulation of Social and Labor Relations of the Energy Sector № 05-13-3-4/PR dated July 25, 2019.
4. International Standard Classification of Education ISCED-2011.
5. International Standard Classification of Occupations ISCO–08.
6. Qualification Directory of Positions for Managers, Specialists, and Other Employees. Order of the Minister of Labor and Social Protection of the Population of the Republic of Kazakhstan dated May 21, 2012, № 201Registered with the Ministry of Justice of the Republic of Kazakhstan on June 25, 2012, № 7755.
7. Law of the Republic of Kazakhstan "On Education," State Compulsory Standard of Higher Education (Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018, № 604, Appendix
8. Professional Standard "Operation and Maintenance of Electrical Equipment" https://pavlodar.atameken.kz/ru/services/16-professionalnyye-standarty-i-tsentry-sertifikatsii-nsk
9. Professional Standard "Forecasting Electricity and Power Consumption" https://pavlodar.atameken.kz/ru/services/16-professionalnyye-standarty-i-tsentry-sertifikatsii-nsk
10. Professional Standard "Organization of Interaction Between Science and Innovators" https://pavlodar.atameken.kz/ru/services/16-professionalnyye-standarty-i-tsentry-sertifikatsii-nsk
11. Professional Standard "Technical Design of Innovative Products/Services" https://pavlodar.atameken.kz/ru/services/16-professionalnyye-standarty-i-tsentry-sertifikatsii-nsk
12. Professional Standard "Development of Working Documentation for Innovative Products/Services" https://pavlodar.atameken.kz/ru/services/16-professionalnyye-standarty-i-tsentry-sertifikatsii-nsk