

«Kazakh National Research Technical University named after K. I. Satbayev»
A. Burkitbaev Institute of Industrial Automation and Digitalization
Department of «Energy»

Working curriculum CURRICULUM PROGRAM

«ELECTRICAL ENGINEERING AND ENERGY»
Master of Engineering and Technology

on the basis of the following specialty of the invalidated Classifier of specialties:
6M071800- "Power Engineering"

1st edition
in accordance with the State Educational Standard of Higher Education 2018

Almaty 2020

Developed:	Reviewed: the meeting of the Institute	Approved: EMC KazNRTU	Page 1 of 36
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The program is drawn up and signed by the parties:

From KazNRTU named after K.I.Satpayev:

1 Head of the
Department of Power Engineering,
PhD, associate professor



Ye. Sarsenbayev

2 Director of the Institute of Industrial
Automation and Digitalization,
PhD



B.Omarbekov

3 Chairman of the educational and
methodological group of the Department
of Power Engineering, Candidate of
Technical Sciences, Associate Professor



Ye. Khidolda

From employers - Director
LLP "Lighting Technologies Kazakhstan"



G.E.Abdykalykov

Approved at a meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K.I. Satbayev. Minutes No. 4 dated 14.01.2020

Qualification:

Level 7 of the National Qualifications

Framework:

7M071 Engineering and Engineering (Master)

Professional competencies: Electric power engineering, electric power systems and networks, relay protection and automation, power supply, renewable energy

Brief description of the program

1 Objectives

The goal of the Master's educational program "Electrical Engineering and Energy" is to train personnel for production with the appropriate professional knowledge and practical skills in the field of electrical energy, capable of solving the problems of improving society, economy and production.

2 Types of work

Master of Engineering and Technology in the educational program "Electrical Engineering and Energy" must have competencies in accordance with the types of professional activity:

- to search, analyze and process information to solve the assigned production tasks;
- demonstrate the ability to plan and conduct experiments, interpret the data obtained and draw conclusions;
- use modern information technologies to solve applied problems;
- choose analytical and numerical methods in the development of mathematical models of electrical installations and systems, technological processes in the electric power industry;
- to demonstrate knowledge for the analysis and synthesis of automatic control systems in the electric power industry;
- know the methods of calculation and selection of power converters of energy and converting equipment;
- choose methods of calculating relay protection devices and analyze the reliability of their operation;
- know the methods of calculation and selection of elements of an automated electric drive;
- use modern systems and methods of electromechanical energy conversion;
- know the methods of calculation and selection of renewable energy sources;
- develop plans for the organization of innovative activities at the enterprise;
- evaluate innovation and technological risks in the introduction of new technologies;
- to know the principles of operation and the specifics of emergency and technological automation of power systems;
- have practical skills in maintenance, repair and diagnostics of industrial digital control systems for electric drives;

- demonstrate the ability to select and use methods and techniques for optimizing energy networks;
- have the ability to install, test, commission and commission electrical and electrical equipment;
- organize and carry out the operation, repair and maintenance of industrial electrical installations;
- know the methods of overvoltage protection, methods of insulation testing and the principles of operation of test installations;
- know the types of high-voltage electrical technologies used;
- be able to use methods of modeling electrical installations and electrical systems.

Educational program "Electrical Engineering and Energy" to provide training for masters in the following activities:

Design and engineering activities

- Ability to compose and develop various simulation models and electrical circuits;
- knowledge to carry out technological and electrical power calculations, to choose electrical and electromechanical equipment;

Design and technological activities

- the ability to substantiate effective operating parameters and indicators of the electric power system;
- knowledge to develop energy-efficient, resource-saving technologies and measures to protect the environment;
- skills to draw up a business plan for a technological project;

Organizational and management activities

- the ability to organize the activities of the team, draw up work plans and set tasks;
- the ability to carry out activities for the organization of production, to develop and draw up the necessary documentation;
- Ability to resolve issues of material and technical support and control over the execution of tasks.

3 Objects of professional activity

Graduates of this specialty can make a career:

- in research organizations;
- in the design and development area of activity;
- in national, transnational energy companies and industrial enterprises.

During the training, industrial practice is provided at such enterprises as: HK KEGOC, AZhK JSC, AIES JSC, NAC «Kazatomprom»,

"KarachaganakPetroleumOperating" and others. Specialized internships at Tomsk Polytechnic University (Russia), Peter the Great St. Petersburg Polytechnic University (Russia) are also provided.

PASSPORT OF THE EDUCATIONAL PROGRAM

1 Scope and content of the program

The term of study in the master's program is determined by the amount of acquired academic credits. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the master's educational program is considered fully mastered. In the profile master's program, at least 90 academic credits for the entire period of study, including all types of educational and additional activities of the master's student.

The planning of the content of education, the method of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of credit technology of education.

The master's degree in the profile direction implements educational programs of postgraduate education for the training of engineering personnel for industrial and design organizations with in-depth profile and research training.

The content of the Master's degree program consists of:

- 1) theoretical training, including the study of cycles of basic and major disciplines;
- 2) practical training of undergraduates: various types of practices, scientific or professional internships;
- 3) experimental research work, including the implementation of a master's thesis - for a specialized master's degree
- 4) final certification.

The professional activity of the graduates of the program covers the field of electric power industry, 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 specialization relates to cinematography and engineering.

Objectives of the educational program

- Based on the achievements of modern science, technology and production, give knowledge and skills in the field of:
- electricity generation and substation;

- electric power networks and systems;
- power supply of enterprises;
- automated electric drive;
- relay protection and automation of electric power systems;
- renewable energy.

- In case of successful completion of the full master's course, the graduate is awarded the academic degree "Master of Engineering and Technology in Engineering and Engineering".

- The educational program of the Master's program "Electrical Engineering and Energy" differs from the existing educational program in the specialty 6M071800 - "Electrical Engineering" by updating the internal content of the disciplines. In the EP of the master's degree, further deepening of the competencies acquired in the bachelor's degree is provided. In this connection, modern innovative disciplines have been introduced into the program:

- energy management system in accordance with international standards;
- modern high voltage equipment;
- management of the energy complex and regulation of the energy sector;
- theory of automated electric drive:
- converting equipment: microprocessor relay protection.

In the process of mastering the educational program, the Master of Engineering and Technology in the field of electric power must acquire the following key competencies:

- to search, analyze and process information to solve the scientific and industrial problems;
- demonstrate the ability to plan and conduct experiments, interpret the data obtained and draw conclusions;
- use modern information technologies to solve applied problems;
- choose analytical and numerical methods in the development of mathematical models of electrical installations and systems, technological processes in the electric power industry;
- to demonstrate knowledge for the analysis and synthesis of automatic control systems in the electric power industry;
- demonstrate the scientific and mathematical principles of the reliability of technical systems;
- know the methods of calculating and choosing power converters of energy and converting equipment;
- choose methods of calculating relay protection devices and analyze the reliability of their operation;
- know the methods of calculation and selection of elements of an automated electric drive; use modern systems and methods of electromechanical energy

conversion; know the methods of calculating and choosing renewable energy sources;

- develop plans for the organization of innovative activities at the enterprise;
- evaluate innovation and technological risks in the introduction of new technologies;

- to know the principles of operation and the specifics of emergency and technological automation of power systems;

- have practical skills in maintenance, repair and diagnostics of industrial digital control systems for electric drives;

- Demonstrate the ability to select and use methods and techniques to optimize energy networks;

- possess the ability to install, test, commission and commission electrical and electrical equipment;

- organize and carry out the operation, repair and maintenance of industrial electrical installations; know the methods of overvoltage protection, methods of testing insulation and the principles of operation of test installations;

- know the types of high-voltage electrical technologies used;

- be able to use methods of modeling electrical installations and electrical systems.

- Educational program «Electrical Engineering and Energy» to provide training of masters in the following activities:

Design and engineering activities

- Ability to compose and develop various simulation models and electrical circuits;

- knowledge to carry out technological and electrical power calculations, to choose electrical and electromechanical equipment;

Design and technological activities

- the ability to substantiate effective operating parameters and indicators of the electric power system;

- knowledge to develop energy-efficient, resource-saving technologies and measures to protect the environment;

- skills to draw up a business plan for a technological project;

Organizational and management activities

- the ability to organize the activities of the team, draw up work plans and set tasks;

- the ability to carry out activities for the organization of production, to develop and draw up the necessary documentation;

- Ability to resolve issues of material and technical support and control over the execution of tasks.

2 Requirements for applicants

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admitting citizens to a magistracy is established in accordance with the "Standard rules for admission to training in educational organizations that implement educational programs of postgraduate education."

The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of citizens' own funds and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive, on a competitive basis, in accordance with the state educational order, free postgraduate education, if they receive education of this level for the first time.

At the "entrance", a master's student must have all the prerequisites necessary for mastering the corresponding educational master's program. The list of required prerequisites is determined by the higher education institution independently. In the absence of the necessary prerequisites, the master student is allowed to master them on a paid basis.

Admission to the university is carried out according to the applications of the applicant who has completed the full bachelor's course in the educational programs "Energy", "Electricity" in accordance with the points of the certificate issued based on the results of testing at the Republican Testing Center in: English, theoretical foundations of electrical engineering, electrical machines

Special requirements for admission to the program apply to graduates of related educational programs: heat power engineering, automation and control.

3 Requirements for completing studies and obtaining a diploma

Awarded degree / qualifications: The graduate of this educational program is awarded the academic degree "master" of engineering and technology in the direction.

A graduate who has mastered master's programs must have the following general professional competencies:

- the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;
- the ability to independently formulate research goals, establish a sequence for solving professional problems;
- the ability to apply in practice the knowledge of fundamental and applied disciplines that determine the focus (profile) of the master's program;
- the ability to professionally choose and creatively use modern scientific and technical equipment for solving scientific and practical problems;
- the ability to critically analyze, represent, defend, discuss and disseminate the results of their professional activities;
- possession of the skills of compiling and preparing scientific and technical documentation, scientific reports, reviews, reports and articles;
- willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;
- readiness for communication in oral and written forms in a foreign language to solve problems of professional activity.

A graduate who has mastered the master's program must have professional competencies corresponding to the types of professional activities that the master's program is focused on:

research activities:

- the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of science and specialized knowledge gained during the master's program;
- the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;
- the ability to create and research models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of production, transmission and consumption of electrical energy;

research and production activities:

- the ability to independently carry out production and research and production field, laboratory and interpretation work in solving practical problems;

- the ability to professionally operate modern field and laboratory equipment and instruments in the field of the mastered master's program;
- the ability to use modern methods of processing and interpreting complex information to solve production problems;
- project activity:
 - the ability to independently compose and submit projects of research and development work;
 - readiness to design complex research and development work in solving professional problems;
- organizational and management activities:
 - the willingness to use the practical skills of organizing and managing research and development work in solving professional problems;
 - readiness for the practical use of regulatory documents in the planning and organization of scientific and industrial work.

When developing a master's program, all general cultural and general professional competencies, as well as professional competencies related to those types of professional activities that the master's program is focused on, are included in the set of required results of mastering the master's program.

Compulsory standard requirements for graduating from a magistracy and awarding an academic degree master of technical sciences: mastering at least 90 academic credits of theoretical education, passing the state exam in the specialty, preparing and defending the final dissertation work before the SJSC.

Special requirements for graduating from a master's degree in this program the graduate should know:

- methods of constructing modern electric power and electromechanical systems;
- modern trends in the development of electrical apparatus and electrical installations, technical means and automation systems for power facilities;
- standards and industry rules, methodological and regulatory materials accompanying the operation, installation, commissioning and design of electric power systems;
- be able to:
 - to develop and research traditional and autonomous power systems using modern technical and technological means.

4. Working curriculum of the educational program

4.1. Study period 1.5 years

WORKING CURRICULUM												
<i>Education program 7M07130 - "Electrical engineering and power engineering"</i>												
<i>Group of Educational Programs M099 - "Power engineering and electrical engineering"</i>												
<i>enrolment for 2020 - 2021 academic year</i>												
Form of study: daytime				Term of study: 1,5 years				Academic degree: Master				
year of study	Code	Name of course	Component	Academic credits	lecture/ lab/ prac/MSIW	Prerequisites	Code	Name of course	Component	Academic credits	lecture/ lab/ prac/MSIW	Prerequisites
1	1 семестр						2 семестр					
	LNG202	Foreign language (professional)	BD IC	6	0/0/3/3	no	ERG266	Renewable energy sources	BD OC	4	1/0/1	no
	MNG274	Management	BD IC	6	2/0/1/3	no	ERG267	Management of power complexes and regulation of the energy sector				
	HUM204	Management Psychology	BD IC	4	1/0/1/2	no	ERG239	Digital control systems of electric drives	PS OC	6	2/1/0/3	no
	ERG258	Theory and practice of relay protection	BD OC	6	2/0/1/3	no	ERG229	Against emergency and technological automation of power supply systems				
	ERG259	Microprocessor relay protection					ERG232	The theory of the automated electric drive				
	ERG246	Modern high voltage equipments	PS OC	6	2/0/1	no	ERG235	The theory of electromechanical energy conversion	PS OC	6	2/1/0	no
	ERG206	High-voltage electrical technologies and equipment					ERG253	ASDC and optimization of the modes of power supply systems				
	ERG217	Installation, commissioning and operation of electrical equipment	PS OC	6	2/1/0	no	ERG247	Energy management system according to international standards	PS OC	6	1/1/1	no
	ERG241	Operation of electric power systems and networks					ERG252	Power electronics				
							ERG257	Conversion technology	PS OC	6	2/1/0	no
						AAP221	Master's student experimental research work, including internship and master's project implementation	MSERW	4			
	In total			34			In total		32			
2	3 семестр											
	AAP246	Work placement	PS	9								
	AAP220	Master's student experimental research work, including internship and master's project implementation	MSERW	14								
	ECA206	Registration and defense of the master's thesis	FA	12								
	In total			35								
	In all			101								

5 Descriptors of the level and amount of knowledge, abilities, skills and competencies

The requirements for the level of preparation of a master's student are determined on the basis of the Dublin descriptors of the second level of higher education (master's degree) and reflect the acquired competencies, expressed in the achieved learning outcomes.

Learning outcomes are formulated both at the level of the entire educational program of the master's program, and at the level of individual modules or academic discipline.

Descriptors reflect learning outcomes that characterize the student's abilities:

1) demonstrate developing knowledge and understanding in the field of electrical power networks and systems, power supply, relay protection and automation, renewable energy, based on advanced knowledge in the field of electrical energy, electrical engineering and electromechanics, while developing and / or applying ideas in the context of research;

2) apply at a professional level their knowledge, understanding and ability to solve problems in a new environment, in a wider interdisciplinary context;

3) collect and interpret information to form judgments, taking into account social, ethical and scientific considerations;

4) clearly and unambiguously communicate information, ideas, conclusions, problems and solutions, both to specialists and non-specialists;

5) learning skills necessary for self-continued further education in the field of electrical power engineering, electrical engineering and electromechanics.

6 Competencies on completion of training

– 6.1 Requirements for key competencies of graduates of a specialized master's program must:

– 1) have an idea:

– about current trends in the development of scientific knowledge;

– about the contradictions and socio-economic consequences of globalization processes;

– 2) know:

– methodology of scientific knowledge;

– principles and structure of the organization of scientific activity;

– 3) be able to:

– use the knowledge gained for the original development and application of ideas in the context of scientific research;

- critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena;
- to integrate the knowledge gained in different disciplines to solve research problems in new unfamiliar conditions;
- by integrating knowledge, make judgments and make decisions based on incomplete or limited information;
- to carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- think creatively and be creative in solving new problems and situations;
- be fluent in a foreign language at a professional level, allowing for research and teaching special disciplines in universities;
- to summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc .;

4) have skills:

- professional communication and intercultural communication;
- oratory, correct and logical design of your thoughts in oral and written form;
- expanding and deepening knowledge necessary for daily professional activities.

5) be competent:

- in the field of research methodology;
- in the implementation of scientific projects and research in the professional field;
- in ways to ensure constant updating of knowledge, expanding professional skills and abilities.

B - basic knowledge, abilities and skills

B1 - capable of philosophical analysis of social phenomena, personality behavior and other phenomena. I am ready to conduct a philosophical assessment of social phenomena;

B2 - know and apply in practice the fundamentals of engineering professional ethics;

B3 - be able to analyze topical problems of the modern history of Kazakhstan.

P - professional competencies

P1 - a wide range of theoretical and practical knowledge in the professional field;

P2 is able to analyze electrical schematic and wiring diagrams of electric power systems.

P3 - ready to install, commission and operate electromechanical and electrical systems;

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P4 - ready to participate in the development and design of new objects of traditional and alternative energy.

O - universal, social and ethical competences

O1 - is able to use English fluently as a means of business communication, a source of new knowledge in the field of electrical engineering and energy; ready to use English in professional activities in the field of electrical energy;

O2 - is able to fluently speak Kazakh (Russian) as a means of business communication, a source of new knowledge in the field of electrical engineering and energy. I am ready to use the Kazakh (Russian) language in professional activities in the field of electric power industry;

O3 - know and apply in work and life the basics of applied ethics and ethics of business communication;

O4 - know and apply the basic concepts of professional ethics;

O5 - to know and solve the problems of human influence on the environment.

C - special and managerial competencies

C1 - independent management and control of the processes of labor and educational activities within the framework of the strategy, policy and goals of the organization, discussion of problems, reasoning of conclusions and competent handling of information;

C2 - to be a specialist in conducting experimental studies of electric power facilities;

C3 - to be a researcher in the study of modern electromechanical and electrical systems;

C3 - be an engineer for the development and design of power systems.

6.2 Requirements for the research work of a master's student in a specialized master's program:

1) corresponds to the profile of the master's educational program, according to which the master's thesis is performed and defended;

2) is relevant and contains scientific novelty and practical significance;

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

4) carried out using modern scientific research methods;

5) contains research (methodological, practical) sections on the main protected provisions;

6) is based on advanced international experience in the relevant field of knowledge.

6.3 Requirements for organizing practices

The educational program of the profile master's degree includes industrial practice, which is carried out in parallel with theoretical training or in a separate period at the place of the dissertation.

The industrial practice is carried out with the aim of acquainting the undergraduate with the latest theoretical, methodological and technological achievements at electric power enterprises, as well as processing and interpreting experimental data in practice.

7 Supplement to the diploma according to ECTS and MES RK

The application was developed according to the standards of the European Commission, Council of Europe and UNESCO / CEPES. This document is for academic recognition only and is not an official proof of education. Not valid without a university degree. The purpose of completing the European Supplement is to provide sufficient information about the holder of the diploma, the qualification obtained, the level of this qualification, the content of the study program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model that will be used to translate grades uses the European Credit Transfer or Transfer System (ECTS).

The European Diploma Supplement provides an opportunity to continue education at foreign universities, as well as to confirm national higher education for foreign employers. When going abroad for professional recognition, additional legalization of the educational diploma will be required. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

8 Description of disciplines

Foreign language (professional)

CODE – LNG205

CREDIT – 3 (0/0/3)

PRE-REQUISIT – AcademicEnglish, BusinessEnglish, IELTS 5.0-5.5

PURPOSE AND OBJECTIVES OF THE COURSE

The aim of the course is to develop students' knowledge of the English language for their ongoing academic research and improve their performance in the field of project management.

SHORT DESCRIPTION OF THE COURSE

The course is aimed at building vocabulary and grammar for effective communication in the field of project management and improving reading, writing, listening and speaking skills at the "Intermediate" level. Students are expected to develop their Business English vocabulary and learn grammatical structures that are often used in a management context. The course consists of 6 modules. The 3rd module of the course ends with an intermediate test, and the 6th module is followed by a test at the end of the course. The course ends with a final exam. Master students also need to study independently (MIS). MIS is an independent work of undergraduates under the guidance of a teacher.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Upon successful completion of the course, students are expected to be able to recognize the main idea and message as well as specific details while listening to monologues, dialogues and group discussions in the context of business and management; understand written and spoken English on topics related to management; write management texts (reports, letters, emails, minutes of meetings) following a generally accepted structure with a higher degree of grammatical accuracy and using business words and phrases, talk about different business situations using appropriate business vocabulary and grammatical structures - in pairs and groups discussions, meetings and negotiations.

Relay protection practice theory

CODE – ERG234

CREDIT – 3 (2/0/1)

PRE-REQUISIT

PURPOSE AND OBJECTIVES OF THE COURSE Master students gain knowledge in the field of principles of construction of relay protection, applied modern methods of calculation, basic elements and means of relay protection. The task of studying the discipline is to expand the understanding of the possibilities of relay protection; consolidation and concretization of the theoretical material concerning the principles of operation and the device of relay protection, their main properties, methods of application; obtaining skills in calculating the parameters necessary for setting up relay protection; the correct choice of methods and means of relay protection; assessment of the effectiveness and reliability of the selected relay protection.

BRIEF DESCRIPTION OF THE COURSE characteristics of relay protection, algorithms of functioning and principles of building protection and methods for calculating various relay protection.

KNOWLEDGE, ABILITY, SKILLS FOR COMPLETION OF THE COURSE informational, methodological and mathematical support for the implementation of relay protection systems; domestic and foreign experience, as well as development prospects in the field of application of relay protection systems; methods for calculating relay protection systems.

know:

- basic concepts, definitions and purpose of relay protection;
- requirements for relay protection;
- principles of construction of relay protection;
- elements and functional parts of relay protection devices;
- operating principles of basic protection circuits with relative and absolute selectivity;

Should be able to:

- calculate the main parameters of relay protection schemes;
- to choose modern elements and devices of relay protection, to analyze their efficiency and reliability;
- read various electrical schematic and wiring diagrams of relay protection of power systems.

Microprocessor relay protection

CODE – ERG211

CREDIT – 3 (2/1/0)

PRE-REQUISIT

PURPOSE AND OBJECTIVES OF THE COURSE Master students gain knowledge in the field of principles of construction of relay protection, applied modern methods of calculation, basic elements and means of relay protection. The task of studying the discipline is to expand the understanding of the possibilities of relay protection; consolidation and concretization of the theoretical material concerning the principles of operation and the device of relay protection, their main properties, methods of application; obtaining skills in calculating the parameters necessary for setting up relay protection; the correct choice of methods and means of relay protection; assessment of the effectiveness and reliability of the selected relay protection.

BRIEF DESCRIPTION OF THE COURSE characteristics of relay protection, algorithms of functioning and principles of building protection and methods for calculating various relay protection.

KNOWLEDGE, ABILITY, SKILLS ON COMPLETION OF THE COURSE Information, methodological and mathematical support for the implementation of relay protection systems; domestic and foreign experience, as well as development prospects in the field of application of relay protection systems; methods for calculating relay protection systems.

know:

- basic concepts, definitions and purpose of relay protection;
- requirements for relay protection;
- principles of construction of relay protection;
- elements and functional parts of relay protection devices;
- operating principles of basic protection circuits with relative and absolute selectivity;

Should be able to:

- calculate the main parameters of relay protection schemes;
- to choose modern elements and devices of relay protection, to analyze their efficiency and reliability;
- read various electrical schematic and wiring diagrams of relay protection of power systems.

Renewable energy sources

CODE – ERG205

CREDIT – 1 (1/0/1)

PRE-REQUISIT– ERG220

PURPOSE AND OBJECTIVES OF THE COURSE

The discipline orients the knowledge gained in chemistry, biology, physics, theoretical foundations of electrical engineering. Carries out their connection with special disciplines, processes and technologies in renewable energy sources, industries. And also shows their connection with special disciplines, processes and technologies for obtaining renewable energy sources from the corresponding applied materials.

SHORT DESCRIPTION OF THE COURSE

The main factors that determine the degree of use of any energy source are its estimated reserves, the net yield of useful energy, cost, potential hazardous impacts on the environment, as well as social consequences and impact on state security.

Renewable energy sources include hydrogen, bioethanol and biogas, artificially obtained from biological waste from agriculture, as well as energy from the sun, water, wind, sea waves, tides, and hydroelectric power plants.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

In the course of studying the discipline, students must understand the concept of providing electricity to consumers, understand the structure of the electric power industry, the relationship between its various links, have an idea of the latest achievements in obtaining renewable energy sources, get an idea of the composition of electricity consumers in various industries.

Energy complex management and regulation of the energy sector

CODE – ERG210

CREDIT – 2 (1/0/1)

PRE-REQUISIT – ERG220

PURPOSE AND OBJECTIVES OF THE COURSE

To prepare a specialist to solve the problems of design, research and operation of electric power and electrotechnological installations and systems, able to analyze the efficiency of energy conversion schemes, assess the prospects of new methods of energy production and introduce innovative developments into practice.

SHORT DESCRIPTION OF THE COURSE

The discipline covers the following theoretical information about the state of development of modern electric power industry:

- the structure and operation of modern power plants of various types and electrical networks;
- principles of construction, structure and optimization of the electric power system of an industrial enterprise;
- the scale, direction and perspective of the production and distribution of energy resources;
- methods of obtaining and requirements for the quality of new types of electrical technology;
- legal and regulatory framework for energy saving;
- fundamentals of energy audit of power facilities;
- principles of wasteless technology, fuel and energy indicators of wastelessness;
- environmental aspects of energy saving.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of studying the discipline, the student must know: the elements of metering and control of energy consumption, the possibilities of energy management and elements of the analysis of investments in energy saving;

Modern high voltage equipment

CODE – ERG236

CREDIT – 2 (1/0/1)

PRE-REQUISIT

PURPOSE AND OBJECTIVES OF THE COURSE

They acquire knowledge about basic information, about the nature of dielectric breakdown, about the design features of high-voltage insulation, about the mechanisms of defects in insulation and methods of its control, about overvoltages and methods of protection against them.

SHORT DESCRIPTION OF THE COURSE

Fundamentals of solid state physics, physical phenomena under the influence of strong electromagnetic fields on gases, liquid and solid dielectrics, the effects of overvoltages arising from direct lightning strikes to objects and transmission lines.

It is based on the knowledge, skills and abilities acquired by the previous study of the disciplines "Electrical materials", "Electrical part of the station and substation", "Electrical networks and systems" studied by undergraduates in previous courses.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Research work in the scientific and pedagogical magistracy should:

- correspond to the main problematics of the specialty in which the master's thesis is being defended;
- be relevant, contain scientific novelty and practical significance;
- be based on modern theoretical, methodological and technological achievements of science and practice;
- carried out using modern methods of scientific research;
- contain research (methodological, practical) sections on the main protected provisions;
- be based on advanced international experience in the relevant field of knowledge.
- performed using advanced information technologies;

High voltage equipment

CODE – ERG206

CREDIT – 2 (1/0/1)

PRE-REQUISIT

The educational program of the profile magistracy includes industrial practice.

The industrial practice of the undergraduate is carried out with the aim of acquainting with the latest theoretical, methodological and technological achievements at energy enterprises, with modern methods of scientific research, processing and interpretation of experimental data.

Experimental research work of a master student

Experimental research work in a specialized master's program should:

- correspond to the main problematics of the specialty in which the master's thesis is being defended;
- be relevant, contain scientific novelty and practical significance;
- be based on modern theoretical, methodological and technological achievements of science and practice;
- carried out using modern methods of scientific research;
- contain research (methodological, practical) sections on the main protected provisions;
- be based on advanced international experience in the relevant field of knowledge.
- performed using advanced information technologies;
- contain experimental and research (methodological, practical) sections on the main protected provisions.

Installation, commissioning and operation of electrical equipment

CODE - ERG217

CREDIT - 3 (2/1/0)

PREREQUISIT - ERG232, ERG235

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of studying the discipline is the formation of theoretical knowledge and mastery of organizational and technical issues of rational operation and advanced industrial methods of installation, commissioning, operation and diagnostics of electrical equipment.

SHORT DESCRIPTION OF THE COURSE

The discipline "Installation, adjustment and operation of electrical equipment" is a basic subject, where students study the accumulated experience of modern methods of organizing and performing work on installation, commissioning and maintenance of electrical installations and automation equipment based on regulatory documents; safety rules, device and technical operation.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of studying this discipline, the undergraduate must have a systematic, integrated approach in solving issues of selection, placement of equipment, installation, adjustment, operation, maintenance and repair, as well as its use for its intended purpose.

Master students will acquire skills in industrial installation, repair and operation of elements of the electric power network in accordance with the requirements of the rules for the technical operation of electrical installations of consumers, safety rules for the operation of electrical installations of consumers and rules for electrical installations.

Operation of electric power systems and networks

CODE - ERG241

CREDIT - 3 (2/1/0)

PRE-REQUISIT

PURPOSE AND OBJECTIVES OF THE COURSE

Familiarization with the main tasks and organizational issues of technical operation, as well as issues of operational reliability.

Smart planning and execution of preventive maintenance, planning and calculating the number of spare parts, and ways to improve operational reliability.

SHORT DESCRIPTION OF THE COURSE

The discipline is based on the knowledge gained in the courses: electrical power engineering, electromechanics and electrical equipment, electrical machines, electrical machines, electrical devices, power supply of enterprises, power grids and systems, the electrical part of power plants, relay protection and automation of power supply systems, the basics of electrical safety.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

The knowledge gained by undergraduates in the study of the discipline "Operation of electric power systems and networks" should provide the final cycle of training on the operation of electrical equipment of industrial enterprises and electrical installations, electric power systems and networks, as well as on some issues of operational reliability.

Scientific and technical problems of the electric power industry

CODE - ERG220

CREDIT - 3 (2/0/1)

PRE-REQUISIT

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

The goal of teaching the discipline is to prepare a specialist to solve the problems of design, research and operation of electric power and electrotechnical installations and systems, able to analyze the efficiency of energy conversion schemes, assess the prospects of new methods of energy production and introduce innovative developments into practice.

SHORT DESCRIPTION OF THE COURSE

The discipline covers the following theoretical information about the state of development of modern electric power industry:

- the structure and operation of modern power plants of various types and electrical networks;
- principles of construction, structure and optimization of the electric power system of an industrial enterprise;
- the scale, direction and perspective of the production and distribution of energy resources;
- methods of obtaining and requirements for the quality of new types of electrical technology;
- legal and regulatory framework for energy saving;
- fundamentals of energy audit of power facilities;
- principles of wasteless technology, fuel and energy indicators of wastelessness;
- environmental aspects of energy saving.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of studying the discipline, undergraduates should know:

- about the structure and functioning of modern power plants and electrical networks;
- on the general principles, structure and functioning of electric power systems and networks;
- about the energy characteristics of electrical processes and installations;
- on the principles of construction, structure and optimization of the electric power system of an industrial enterprise;

- on the variety of electrical processes and installations, on the main types and classification of electrical equipment;
- on the scale, directions and prospects of production and distribution of energy carriers;
- on the methods of obtaining and requirements for the quality of new types of electrical technology;
- on the legal and regulatory framework for energy conservation;
- about the basics of energy audit of power facilities;
- on the principles of wasteless technology, on the fuel and energy indicators of wastelessness.

As a result of studying the discipline, undergraduates should have an idea of:

- on the main directions of fundamental research in electrical power engineering and electrical technology;
- on the structure and functioning of power plants of various types and on the combined generation of electricity and heat at CHP;
- on the principles and methods of developing energy saving measures.

As a result of studying the discipline, undergraduates must possess:

- the methods of calculating the energy indicators of power plants;
- methods for calculating the energy characteristics of electricity production;
- methods for calculating the characteristics of energy carriers used in electrotechnical production;
- methods for calculating the main characteristics of energy carriers;
- methods of optimization of power plants and systems.

Modeling the elements of electric power systems

CODE - ERG214

CREDIT - 3 (2/1/0)

PRE-REQUISIT - no

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching the discipline is to form a complex of knowledge, skills and abilities in the field of research of electric power systems based on mathematical modeling to automate the management of complex technical objects.

SHORT DESCRIPTION OF THE COURSE

The module is devoted to the issues of mathematical modeling of elements of electric power systems. The general principles of mathematical modeling are considered, mathematical models of the main elements of electric power systems are studied with the derivation of the main differential equations. Methods of automated control based on the mathematical theory of optimization and control are considered.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

In the process of studying this, the undergraduate forms the following competencies:

- the ability to apply methods, algorithms and tools for automating complex technological processes and industrial production (PC-1);
- readiness to use modern tools and information and communication technologies in the design and implementation of control systems for technological processes and production (PC-2).

ASDU and optimization of power systems modes

CODE - ERG203

CREDIT –3 (1/1/1)

PRE-REQUISIT - ERG222

PURPOSE AND OBJECTIVES OF THE COURSE

The objectives of mastering the discipline are: the formation of knowledge about the tasks, structure, features of energy and energy systems, technological features of energy systems, about electrical modes and the possibilities of managing them, tasks of operational control in conditions of automated dispatch control systems (ASDU), compatibility of the control system in the power industry with biological environments, the formation of skills and abilities to manage the modes of power systems, optimization calculations and analysis of technical and economic indicators of networks; planning and forecasting modes, choosing the optimal composition of operating equipment in the power system.

SHORT DESCRIPTION OF THE COURSE

The discipline belongs to the "Professional Cycle" of the basic part of the "Power Engineering" module. The specified discipline is one of the basic ones; has both independent significance and is the basis for a number of special disciplines.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

To successfully master the discipline, the student must:

know: laws of electrical engineering; basic elements of electrical systems;

be able to: draw up equivalent circuits for the elements of the power system;

Apply and analyze information, solve engineering problems in the field of electromechanical energy conversion. Perform various tasks of analyzing the operation of electromechanical converters using mathematical modeling methods, develop recommendations for optimizing EMF operating modes. Development of design solutions for the execution of electromechanical converters for various applications.

Energy management system according to international standards

CODE - ERG243

CREDIT - 3 (2/0/1)

PRE-REQUISIT

PURPOSE AND OBJECTIVES OF THE COURSE

To prepare a specialist to solve the problems of design, research and operation of electric power and electrotechnological installations and systems, able to analyze the efficiency of energy conversion schemes, assess the prospects of new methods of energy production and introduce innovative developments into practice.

SHORT DESCRIPTION OF THE COURSE

The discipline covers the following theoretical information about the state of development of modern electric power industry:

- the structure and operation of modern power plants of various types and electrical networks;
- principles of construction, structure and optimization of the electric power system of an industrial enterprise;
- the scale, direction and perspective of the production and distribution of energy resources;
- methods of obtaining and requirements for the quality of new types of electrical technology;
- legal and regulatory framework for energy saving;
- fundamentals of energy audit of power facilities;
- principles of wasteless technology, fuel and energy indicators of wastelessness;
- environmental aspects of energy saving.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

- the ability to identify promising areas in the energy sector;
- to understand general and particular problems in the energy sector;
- read and cite scientific literature;
- analyze a scientific publication;
- use scientific methods of analysis.

Power electronics

CODE - ERG230

CREDIT - 2 (1/1/0)

PRE-REQUISIT

PURPOSE AND OBJECTIVES OF THE COURSE

Familiarization of undergraduates with the basics of power electronics, with the main elements of power electronics, about their application in industrial conversion devices and the formation of master's students' skills in working with them.

SHORT DESCRIPTION OF THE COURSE

The course covers the following main topics: power electronic devices; element base and typical units of control systems; converters with network switching; DC to DC conversion; controlled converters; pulse-width modulation in converters; resonant converters; the use of power electronics devices.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of mastering the discipline "Power Electronics" the student will know:

- the main element base of power electronics;
- the principle of operation and characteristics of the main electronic devices;

- device of power converters;
- the use of power converters;

be able to:

- read electronic circuits;
- to carry out basic calculations of power electronic devices;
- to collect circuits of power converters;
- identify faults in the converter circuits;

own:

- methods of calculating the most common converting devices;
- skills in working with electronic converters.

Conversion technology

CODE - ROB130

CREDIT - 2 (1/1/0)

PRE-REQUISIT - AUT

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of this course is to give undergraduates a fairly complete understanding of rectifier converters, their constituent elements, topology, mathematical descriptions, basic methods of analysis, calculation and rational choice of elements, i.e. in creating a scientific and practical basis for the subsequent study of special disciplines and direct application in further practical activities.

The objectives of the course are to master the theory of physical phenomena in rectifier converters and determine the design ratios that allow for a given operating mode of the consumer (load) to determine the electrical parameters for the selection of semiconductor devices, transformers, filters, as well as instilling practical skills in using methods of analysis and calculation of electrical parameters to solve a wide range of engineering problems.

SHORT DESCRIPTION OF THE COURSE

This lecture course is devoted to the first of these parts of the converter technology - rectifiers. The content of the course and the sequence of presentation of the material in it generally corresponds to the program of the discipline "Conversion technology" for electrical engineering specialties of universities.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of studying the course, the student must know the basic methods of analysis and calculation of physical processes in the elements of rectifier converters of various configurations and be able to apply the knowledge gained in practice.

Theory of an automated electric drive

CODE - ERG232

CREDIT - 3 (2/1/0)

PREQUISIT - ERG220

PURPOSE AND OBJECTIVES OF THE COURSE to bring to the undergraduate the importance of the electric drive in modern scientific and technological progress. To study the basics of an electric drive: electromechanical properties of AC and DC motors, transient processes in electric drives, methods of choosing the power of motors.

The objective of the discipline is to study and develop various electric drive systems: drawing up schematic diagrams, forming the required static characteristics of motors, calculating and choosing electric motors.

SHORT DESCRIPTION OF THE COURSE

The course sets out general questions of the theory of an automated electric drive. The static and dynamic properties of open-loop electromechanical systems are considered, as well as the issues of parametric and automatic control of their main coordinates and the choice of motors.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Undergraduates learn how to experimentally obtain data for constructing the characteristics of motors, calculate and select electric motors.

The theory of electromechanical energy conversion

CODE - ERG235

CREDIT - 3 (2/1/0)

PREQUISIT - ERG220

PURPOSE AND OBJECTIVES OF THE COURSE

Formation of general scientific knowledge and in-depth professional training of the undergraduate on the basis of students studying the basics of the theory of electromechanical energy conversion, modern electromechanical systems, methods of mathematical description and modeling of electromechanical energy conversion processes.

SHORT DESCRIPTION OF THE COURSE

Discipline "Theory of electromechanical conversion of electricity", where students study issues related to the basic laws of electromechanical conversion of energy, the device and the principle of operation of electromechanical converters. Learn to calculate the electromagnetic forces and electromagnetic moments in electromechanical energy converters.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Basic methods, ways and means of obtaining, storing and processing information; basic concepts and content of classical sections of electromechanics of basic physical phenomena and laws of mechanics, electrical engineering, power engineering and their mathematical description; the main methods of experimental research of objects and systems of electric power and electrical engineering.

Use of modern technical means and information technologies in the professional field; methods of mathematical and physical modeling of modes, processes, states of objects of electric power industry and electrical engineering, analysis of physical phenomena in technical devices and systems.

Apply and analyze information, solve engineering problems in the field of electromechanical energy conversion. Perform various tasks of analyzing the operation of electromechanical converters using mathematical modeling methods, develop recommendations for optimizing EMF operating modes. Development of design solutions for the execution of electromechanical converters for various applications.

Master's thesis defense

CODE - ECA205

CREDIT - 12

The purpose of the master's thesis is:
demonstration of the level of applied / research qualifications of a master's student, the ability to independently conduct scientific research, test the ability to solve specific scientific and practical problems, knowledge of the most general methods and techniques for their solution.

SHORT DESCRIPTION

A master's thesis is a final qualifying scientific work, which is a generalization of the results of an independent study by a master student of one of the urgent problems of a specific specialty of the corresponding branch of science, which has internal unity and reflects the course and results of the development of the chosen topic.

The master's thesis is the result of the experimental research work of the master student, carried out during the entire period of the master's student's training.

The defense of a master's thesis is the final stage of the master's preparation. A master's thesis must meet the following requirements:

- in the work, research should be carried out or urgent problems in the field of electrical engineering and power engineering should be solved;
- the work should be based on the definition of important scientific problems and their solution;
- decisions must be scientifically grounded and reliable, have internal unity;
- the thesis should be written individually.

Content

- 1 Scope and content of the program
- 2 Requirements for applicants
- 3 Requirements for completing studies and obtaining a diploma
- 4 Working curriculum of the educational program
- 5 Descriptors of the level and amount of knowledge, abilities, skills and competencies
- 6 Competencies on completion of training
- 7 ECTS Diploma Supplement
- 8 Description of disciplines