

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"KYIV POLYTECHNICAL INSTITUTE named after Igor Sikorsky"**

APPROVED

Academic Council of KPI. Igor Sikorsky
(Minutes № ____ from " ____ " _____ 20 ____)

Chairman of the Academic Council

_____ Mykhailo ILCHENKO

**ELECTROTECHNICAL DEVICES AND
ELECTROTECHNOLOGICAL COMPLEXES**

**ELECTROTECHNICAL DEVICES AND
ELECTROTECHNOLOGICAL COMPLEXES**

EDUCATIONAL PROFESSIONAL PROGRAM

first (bachelor's) level of higher education

specialty	141 - "Electric power, electrical engineering and electromechanics"
field of knowledge	14 - "Electrical Engineering"
qualification	Bachelor of Electrical Engineering, Electrical Engineering and Electromechanics

Put into effect by order of the rector

KPI them. Igor Sikorsky

order № _____ from " ____ " _____ 20 ____

Kyiv - 2020

PREAMBLE

DEVELOPED by the project team:

Project team leader:

Trotsenko Eugene Alexandrovich, Associate Professor, Associate Professor, Candidate of Technical Sciences

Project team members:

Ostroverkhov Mykola Yakovych, Head of the Department, Professor, Doctor of Technical Sciences

Brzezycki Volodymyr Oleksandrovych, professor, professor, doctor of technical sciences

Protsenko Alexander Rostislavovich, associate professor, associate professor, candidate of technical sciences

The Department of Theoretical Electrical Engineering is responsible for the training of applicants for higher education according to the educational program

AGREED:

Scientific and methodical commission of KPI named after Igor Sikorsky, majoring in 141 "Power Engineering, Electrical Engineering and Electromechanics"

Chairman of the NMCU 141 _____ Alexander YANDULSKY

(Minutes №__ of "___" _____ 2020)

Methodical council of KPI named after Igor Sikorsky

Chairman of the Methodical Council _____ Yuriy YAKYMENKO

(Minutes №__ of _____ 2020)

INCLUDED:

The standard of higher education in the specialty 141 "Electric power, electrical engineering and electromechanics" was approved (order of the Ministry of Education and Science №867 of 20.06.2019).

Comments and suggestions of stakeholders based on the results of the discussion:

- scientific and pedagogical staff of the Department of Theoretical Electrical Engineering;

- *applicants for higher education who study under the educational program "Electrical devices and electrical systems";*
- *review by the director of IKNET LLC Podoliak Yuriy Oleksandrovych.*

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1. PROFILE OF THE EDUCATIONAL PROGRAM

in specialty 141 - "Power Engineering, Electrical Engineering and Electromechanics"

1 - General information	
Full name of ZVO and institute / faculty	National Technical University of Ukraine, Kyiv Polytechnic Institute named after Igor Sikorsky, Faculty of Electrical Engineering and Automation
Degree of higher education and title of qualification in the original language	Degree - Bachelor Qualification - Bachelor of Electrical Engineering, Electrical Engineering and Electromechanics
The official name of the OP	Electrotechnical devices and electrotechnological complexes
Type of diploma and scope of OP	Bachelor's degree, single, 240 credits, term of study 3 years 10 months
Availability of accreditation	ND certificate № 1192558 (070862) dated 25.09.2017, issued by the Ministry of Education and Science of Ukraine, valid until 01.07.2023.
Cycle / level of VO	NRC of Ukraine - level 6, FQ-EHEA - first cycle, EQF-LLL - 6 level
Prerequisites	Availability of complete general secondary education
Language (s) of instruction	Ukrainian
Validity of the OP	Until the next accreditation
Internet address of the permanent placement of the educational program	https://toe.fea.kpi.ua/profile_programs.html http://osvita.kpi.ua/op (section "Educational programs")
2 - The purpose of the educational program	
Training of a specialist capable of solving complex specialized problems and practical problems in the field of power and electrical engineering, which involves the application of theories and principles of operation of electrical devices and electrical systems and is able to work in the conditions of sustainable innovative scientific and technical development of society also in the conditions of labor market transformation through interaction with employers and other stakeholders.	
3 - Characteristics of the educational program	
Subject area	<p><i>Objects of study and activity:</i> enterprises electric power complex, electrical and electromechanical services of organizations; production, transmission, distribution and conversion of electricity at power plants, power grids and systems; electrotechnical equipment, electromechanical and switching equipment, electromechanical and electrotechnical complexes and systems.</p> <p><i>Learning purpose:</i> Training of capable specialists to solve specialized problems and practical problems of electric power, electrical engineering and electromechanics, which involves the application of theories and methods of physics and engineering and is characterized by complexity and uncertainty of conditions.</p> <p><i>Theoretical content of the subject area:</i> basic concepts of the theory of electric and electromagnetic circuits,</p>

	<p>modeling, optimization and analysis of modes of operation of power plants, networks and systems, electric machines, electric drives, electrical and electromechanical systems and complexes using traditional and renewable energy sources.</p> <p><i>Methods, techniques and technologies:</i> analytical methods</p> <p>calculation of electrical circuits, power supply systems, electrical machines and devices, control systems for electrical and electromechanical systems, electrical loads using specialized laboratory equipment, personal computers and other equipment.</p> <p><i>Tools and equipment:</i> control and measuring devices, electrical and electronic devices, microcontrollers, computers.</p>
Orientation OP	Educational and professional
The main focus of the OP	<p>Special education in the field of power engineering, electrical engineering and electromechanics.</p> <p>The program is based on well-known scientific principles, taking into account the current state of development of the energy sector, focuses on current areas in which further professional and scientific careers are possible: testing and operation of electrical devices; development and implementation of electrotechnological complexes and systems.</p> <p>Key words: electricity, electric power industry, electrical engineering, electromechanics, energy saving, energy management, automation, devices, electrotechnological complexes.</p>
Features of OP	<p>General higher education in the field of electrical engineering, electrical engineering and electromechanics, which is a field of technology that includes a set of tools, methods and techniques of human activity designed to use electricity, control its flows and convert other energy into electricity, including high-efficiency electrical systems, electrical devices and electrical equipment for high-tech industries of electric power, electromechanics, electrical engineering, industry, transport, agriculture, everyday life and special purpose with the use of computer-integrated technologies and automation tools.</p> <p>ATdominance of additional fundamental and professionally-oriented disciplines, which together provides the acquisition of the necessary competencies for further professional activity.</p> <p>Aimed at forming the applicant's ability to identify and solve complex problems in the field of knowledge 14 "Electrical Engineering" within the specialty 141 "Power Engineering, Electrical Engineering and Electromechanics". The program gives students the opportunity to freely choose disciplines according to the profile of the department.</p>

	<p>The possibility of training foreign students at the Center for International Education KPI. Igor Sikorsky.</p> <p>Carrying out of practice of students on manufactures of branch.</p>
4 - Suitability of graduates for employment and further study	
Suitability for employment	<p>Specialists are able to hold positions, the qualification requirements of which provide for a bachelor's degree in electrical engineering, electrical engineering and electromechanics, in the subjects management carrying out the following types of economic activity (according to NACE-2010):</p> <p>27.1 Manufacture of electric motors, generators, transformers, electrical distribution and control equipment;</p> <p>27.2 Manufacture of batteries and accumulators;</p> <p>27.3 Manufacture of wires, cables and electrical devices;</p> <p>27.4 Manufacture of electric lighting equipment;</p> <p>27.5 Manufacture of household appliances;</p> <p>27.9 Manufacture of other electrical equipment;</p> <p>33.14 Repair and maintenance of electrical equipment;</p> <p>33.20 Installation and assembly of machines and equipment;</p> <p>35.11 Electricity generation;</p> <p>35.12 Transmission of electricity;</p> <p>35.13 Distribution of electricity;</p> <p>35.14 Electricity trade;</p> <p>42.22 Construction of electricity and telecommunications facilities;</p> <p>43.21 Electrical work.</p> <p>Specialists can be employed in positions (according to the current Classifier of Professions of Ukraine DK 003: 2010).</p>
Further training	Continuation of education at the second (master's) level of higher education and / or acquisition of additional qualifications in the system of postgraduate education.
5 - Teaching and assessment	
Teaching and learning	Lectures, practical and seminar classes, computer workshops and laboratory works; technology of blended learning, practice; execution of the dissertation
Evaluation	Rating system, assessment, oral and written exams, testing
6 - Program competencies	
Integral competence	Ability to solve specialized problems and solve practical problems during professional activities in the field of power engineering, electrical engineering and electromechanics or in the learning process, which involves the application of theories and methods of physics and engineering and are characterized by complexity and uncertainty.
General competencies	K01. Ability to abstract thinking, analysis and synthesis.

	<p>K02. Ability to apply knowledge in practice situations.</p> <p>K03. Ability to communicate in the state language both orally and in writing.</p> <p>K04. Ability to communicate in a foreign language.</p> <p>K05. Ability to search, process and analyze information from various sources.</p> <p>K06. Ability to identify, pose and solve problems.</p> <p>K07. Ability to work in a team.</p> <p>K08. Ability to work autonomously.</p> <p>K09. The ability to exercise their rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine.</p> <p>K10. Ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, techniques and technologies. active recreation and a healthy lifestyle.</p>
Professional competencies	<p>K11. Ability to solve practical problems using computer-aided design and calculation (CAD) systems.</p> <p>K12. Ability to solve practical problems involving methods of mathematics, physics and electrical engineering.</p> <p>K13. Ability to solve complex specialized problems and practical problems related to the operation of electrical systems and networks, electrical part of stations and substations and high voltage equipment.</p> <p>K14. Ability to solve complex specialized problems and practical problems related to the problems of metrology, electrical measurements, the operation of automatic control devices, relay protection and automation.</p> <p>K15. Ability to solve complex specialized problems and practical problems associated with the operation of electric machines, devices and automated electric drive.</p> <p>K16. Ability to solve complex specialized problems and practical problems related to the problems of production, transmission and distribution of electricity.</p> <p>K17. Ability to develop projects of electric power, electrotechnical and electromechanical equipment with observance of requirements of the legislation, standards and technical task.</p> <p>K18. Ability to perform professional duties in compliance with the rules of safety, labor protection, industrial sanitation and environmental protection.</p> <p>K19. Awareness of the need to increase the efficiency of electrical, electrical and electromechanical equipment.</p> <p>K20. Awareness of the need to constantly expand their</p>

	<p>knowledge of new technologies in power engineering, electrical engineering and electromechanics.</p> <p>K21. Ability to promptly take effective measures in emergency (emergency) situations in power and electromechanical systems.</p> <p>K22. Ability to develop projects of automated process control systems based on microprocessor technology.</p> <p>K23. Ability to use methods of modern theory of control of complex objects, estimation of a condition and their parameters, adaptive adjustment of parameters of digital regulators for creation of the automated control systems of technological processes on the basis of microprocessor controllers.</p> <p>K24. Ability to solve problems of meeting the needs of electricity production of various types and parameters, as well as to effectively control its distribution and increase energy efficiency with the help of power electronics devices and converters.</p> <p>K25. Ability to use electrical devices to provide control and protection of electrical installations that consume electricity.</p> <p>K26. Ability to use electrical devices to control start-up, speed control and implementation of electric braking of electric motors, regulation of currents and voltages of generators.</p> <p>K27. Ability to apply modern methods of control and assessment of the technical condition of electrical equipment insulation and methods to maintain long-term performance of electrical equipment.</p> <p>K28. Ability to solve problems of 3D modeling and design of power and electrical installations using electrical systems of computer-aided design.</p>
7 - Program learning outcomes	
<p>PR01. Know and understand the principles of operation of electrical systems and networks, power equipment of power plants and substations, protective earthing and lightning protection devices and be able to use them to solve practical problems in professional activities.</p> <p>PR02. Know and understand the theoretical foundations of metrology and electrical measurements, the principles of automatic control devices, relay protection and automation, have the skills to perform appropriate measurements and use these devices to solve professional problems.</p> <p>PR03. Know the principles of operation of electric machines, devices and automated electric drives and be able to use them to solve practical problems in professional activities.</p> <p>PR04. Know the principles of operation of bioenergy, wind, hydro and solar power plants.</p> <p>PR05. Know the basics of the theory of the electromagnetic field, methods of calculating electric circuits and be able to use them to solve practical problems in professional activities.</p> <p>PR06. Use application software, microcontrollers and microprocessor technology to solve practical problems in professional activities.</p> <p>PR07. To carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems.</p> <p>PR08. Select and apply suitable methods for analysis and synthesis of electromechanical and electrical systems with specified parameters.</p>	

- PR09. Be able to assess the energy efficiency and reliability of electrical, electrical and electromechanical systems.
- PR10. Find the necessary information in the scientific and technical literature, databases and other sources of information, assess its relevance and reliability.
- PR11. To communicate freely on professional problems in the state and foreign languages orally and in writing, to discuss the results of professional activity with specialists and non-specialists, to argue their position on debatable issues.
- PR12. Understand the basic principles and objectives of technical and environmental safety of electrical engineering and electromechanics, take them into account when making decisions.
- PR13. Understand the importance of traditional and renewable energy for successful economic development of the country.
- PR14. Understand the principles of European democracy and respect for the rights of citizens, take them into account in decision-making.
- PR15. Understand and demonstrate good professional, social and emotional behavior, follow a healthy lifestyle.
- PR16. Know the requirements of regulations relating to engineering, protection of intellectual property, labor protection, safety and industrial sanitation, take them into account when making decisions.
- PR17. Solve complex specialized problems in the design and maintenance of electromechanical systems, electrical equipment of power plants, substations, systems and networks.
- PR18. Be able to learn independently, acquire new knowledge and improve skills in working with modern equipment, measuring equipment and application software.
- PR19. Apply suitable empirical and theoretical methods to reduce electricity losses during its production, transportation, distribution and use.
- PR20. Know and understand the principles of automated process control systems.
- PR21. Know and understand the theoretical, methodological and engineering foundations of the creation and implementation of automated process control systems.
- PR22. Be able to work with general software automated process control systems.
- PR23. Know and understand the physical basis and architecture of microprocessors, the methodology of designing devices based on microprocessors.
- PR24. Know and understand the principles of operation of power converters for dynamic and static transformation of electrical energy in electrical installations.
- PR25. Know and understand the principles of operation of electrical devices for control of electrical installations and devices for protection of electrical equipment and electrical networks.
- PR26. Know the basic types and electrical characteristics of internal and external insulation of electrical installations and open switchgear, methods of estimating the actual insulation life of power electrical equipment.
- PR27. Know and be able to work with specialized software for finite element analysis, solving and simulation for various physical, electrical and mechanical applications.

8 - Resource support for program implementation

Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 dated 10.05.2018.
Logistics	In accordance with the technological requirements for material and technical support of educational activities of the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 №

	1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 dated 10.05.2018. Use of equipment for lectures in the format of presentations, network technologies, in particular on the Sikorsky distance learning platform.
Information and educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the relevant level of HE (Annex 5 to the License Terms), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 from 10.05.2018 Use of the Scientific and Technical Library of KPI named after Igor Sikorsky.
9 - Academic mobility	
National credit mobility	Possibility of concluding agreements on academic mobility, double graduation, etc.
International credit mobility	It is possible to conclude agreements on international academic mobility, on double graduation, on long-term international projects, which include inclusive postgraduate training, etc. International projects: Erasmus + project (KA1) with West Pomeranian University of Technology in Szczecin, Poland DAAD project with the Technical University of Hesse - University of Applied Sciences, Hesse, Germany (Technische Hochschule Mittelhessen - University of Applied Sciences) Erasmus + project (KA1) with the University of Lorraine, Minnes Nancy High School, Nancy, France (Universite de Lorraine Ecole Nationale Superieur des Mines Nancy, ville Nancy, France) Erasmus + project (KA1) with the University of Le Mans, the city of Le Mans, France (Université du Maine, ville Le Mans, France) Erasmus + project (KA1) with the University of Applied Sciences in Giessen, Germany (Technische Hochschule Mittelhessen)
Training of foreign applicants VO	Teaching in Ukrainian

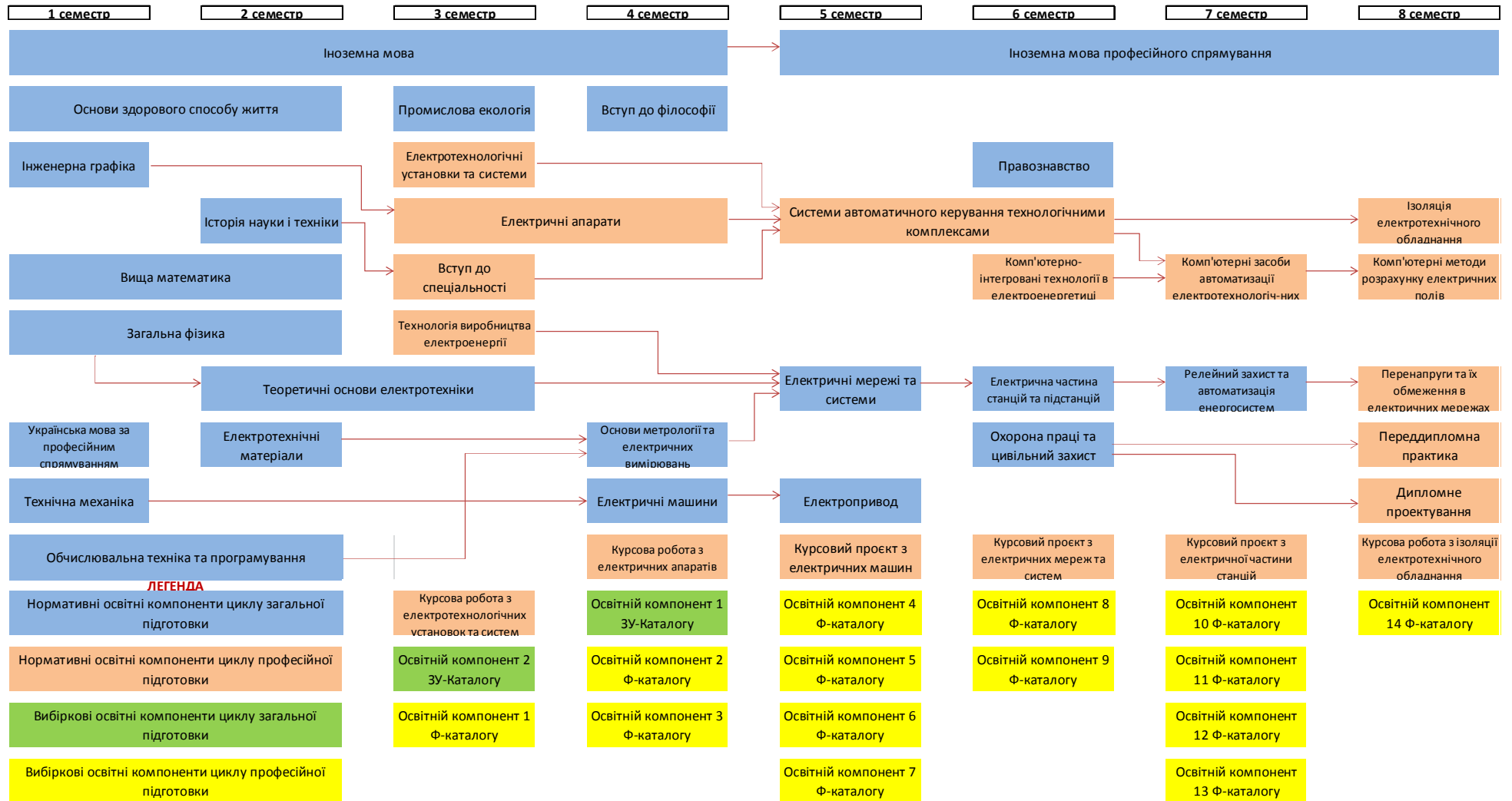
2. LIST OF COMPONENTS OF THE EDUCATIONAL- PROFESSIONAL PROGRAM

Code n / a	Components of the educational program (academic disciplines, term papers, term projects, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
Mandatory (regulatory) components of OP			

1	2	3	4
General training cycle			
3O 1	Ukrainian language for professional purposes	2	Test
3O 2	History of science and technology	2	Test
3O 3	Basics of a healthy lifestyle	3	Test
3O 4	Foreign Language	6	Test
3O 5	Labor protection and civil protection	4	Test
3O 6	science of law	2	Test
3O 7	Introduction to philosophy	2	Test
3O 8	Industrial ecology	2	Test
3O 9	Foreign language for professional purposes	6	Examination
3O 10	Higher mathematics	15	Examination
3O 11	general Physics	9	Examination
3O 12	Computing and programming	11	Test
3O 13	Engineering graphics	3	Test
3O 14	Technical mechanics	3	Test
3O 15	Electrical materials	3	Test
3O 16	Fundamentals of metrology and electrical measurements	4	Examination
3O 17	Theoretical foundations of electrical engineering	10	Examination
3O 18	Electric machines	5	Examination
3O 19	Electrical part of stations and substations	4	Examination
3O 20	Electric drive	3	Examination
3O 21	Electrical networks and systems	5	Examination
3O 22	Relay protection and automation of power systems	4	Examination
Cycle of professional training			
ON 1	Electricity production technology	3	Test
ON 2	Introduction to	3	Test
ON 3	Electrical installations and systems	4	Examination
ON 4	Electrical appliances	12	Examination
ON 5	Systems of automatic control of technological complexes	7	Examination
ON 6	Computer-integrated technologies in electric power industry	5	Examination
ON 7	Computer methods for calculating electric fields	4	Test
ON 8	Computer means of automation of electrotechnological complexes and systems	7.5	Examination
ON 9	Overvoltages and their limitations in electrical networks	3	Test
ON 10	Insulation of electrical equipment	4	Examination
ON 11	Course work on electrical installations and systems	1	Test
ON 12	Course work on electrical devices	1	Test
ON 13	Course project on electric machines	1.5	Test
ON 14	Course project on electrical networks and systems	1.5	Test
ON 15	Course project on the electrical part of the stations	1.5	Test
ON 16	Course work on the insulation of electrical equipment	1	Test

1	2	3	4
ON 17	Pre-diploma practice	6	Test
ON 18	Diploma design	6	Protection
Selective components of OP			
General training cycle			
ZV 1	Educational component 1 of the Memory Catalog	2	Test
ZV 2	Educational component 2 of the Memory Catalog	2	Test
Cycle of professional training			
PV 1	Educational component 1 of the F-Catalog	4	Test
PV 2	Educational component 2 of the F-Catalog	4	Test
PV 3	Educational component 3 of the F-Catalog	4	Test
PV 4	Educational component 4 of the F-Catalog	4	Test
PV 5	Educational component 5 of the F-Catalog	4	Test
PV 6	Educational component 6 of the F-Catalog	4	Test
PV 7	Educational component 7 of the F-Catalog	4	Test
PV 8	Educational component 8 of the F-Catalog	4	Test
PV 9	Educational component 9 of the F-Catalog	4	Test
PV 10	Educational component 10 of the F-Catalog	4	Test
PV 11	Educational component 11 of the F-Catalog	4	Test
PV 12	Educational component 12 of the F-Catalog	4	Test
PV 13	Educational component 13 of the F-Catalog	4	Test
PV 14	Educational component 14 of the F-Catalog	4	Test
Total amount of compulsory educational components:		180 credits	
The total amount of selective educational components:		60 Credits	
The scope of educational components that ensure the acquisition of competencies of certain SVO:		120 Credits	
TOTAL VOLUME OF THE EDUCATIONAL PROGRAM:		240 credits	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Certification of higher education students under the educational-professional program "Electrical devices and electrotechnological complexes" specialty 141 "Electric power, electrical engineering and electromechanics" is carried out in the form of defense of qualification work and ends with the issuance of a standard document on awarding its holder electrical engineering and electromechanics.

The qualification work is checked for the absence of academic plagiarism, fabrication and falsification and after the defense is placed in the repository of the NTB of the University for free access. Graduation certification is carried out openly and publicly.

5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

	30 1	30 2	30 3	30 4	30 5	30 6	30 7	30 8	30 9	30 10	30 11	30 12	30 13	30 14	30 15	30 16	30 17	30 18	30 19	30 20	30 21	30 22	ON 1	ON 2	ON 3	ON 4	ON 5	ON 6	ON 7	ON 8	ON 9	ON 10	ON 11	ON 12	ON 13	ON 14	ON 15	ON 16	ON 17	ON 18					
K0 1							+	+	+	+									+	+						+												+	+						
K0 2					+	+				+	+		+	+						+								+											+	+					
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