

**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 AND SCIENTIFIC PROGRAM

second (master's) level of higher education

specialty	141 - "Electric power, electrical engineering and electromechanics"
field of knowledge	14 - "Electrical Engineering"
educational qualification	Master's degree in electrical engineering, electrical engineering and electromechanics

Put into effect by order of the rector

KPI them. Igor Sikorsky

order № _____ from " ____ " _____ 20____

Kyiv - 2021

PREAMBLE

DEVELOPED by the project team:

Project team leader:

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

Project team members:

Brzezycki Volodymyr Oleksandrovych, professor Department of Theoretical Electrical Engineering, Professor, Doctor of Technical Sciences

Trotsenko Eugene Alexandrovich, Associate Professor Department of Theoretical Electrical Engineering, Associate Professor, Candidate of Technical Sciences

Protsenko Alexander Rostislavovich, associate professor Department of Theoretical Electrical Engineering, 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

(protocol №__ from "___" _____ 20__)

Methodical council of KPI named after Igor Sikorsky

Chairman of the Methodical Council _____ Yuriy YAKYMENKO

(Minutes №__ of _____ 20__)

INCLUDED:

Comments and suggestions of stakeholders on the results of the discussion on updating the educational components:

- 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.

The educational and scientific program "Electrical devices and electrotechnological complexes" of the second (master's) level of higher education was discussed and approved by research and teaching staff at a meeting of the Department of Theoretical Electrical Engineering (Minutes №6 from 27.01.2021).

CONTENT

1. Profile of the educational program.....	5
2. List of components of the educational component of the educational and scientific program.....	12
3. Structural and logical scheme of the educational program	14
4. Form of certification of applicants for higher education	15
5. Matrix of correspondence of program competencies to the components of the educational program.....	16
6. Matrix of providing program learning outcomes with relevant components of the educational program.....	18

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 - Master Qualification - Master 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	Master's degree, single, 120 ECTS credits, term of study 1 year 9 months
Availability of accreditation	ND certificate № 1192630 (070932) dated 25.09.2017, issued by the Ministry of Education and Science of Ukraine, valid until 01.07.2024.
Cycle / level of VO	NRC of Ukraine - level 7 QF-EHEA - second cycle EQF-LLL - level 7
Prerequisites	Having a bachelor's degree
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 problems and problems in the power, electrical and electromechanical industries and to carry out innovative professional and scientific activities, which involves the application of theories and principles of electrical devices and electrical systems and is able to work in a sustainable innovative scientific and technological development of society and in the transformation of the labor market through interaction with employers and other stakeholders.	
3 - Characteristics of the educational program	
Subject area	Field of knowledge: 14 "Electrical Engineering" Specialty: 141 "Electric power, electrical engineering and electromechanics" <i>Objects of study and activity:</i> scientific institutions, establishments and organizations in the field of electric power, electrical engineering and electromechanics, enterprises of the electric power complex, electrotechnical and electromechanical companies; processes of production, transmission, distribution and consumption of electric energy at power plants, in electric networks and systems; processes of conversion of electric energy in electromechanical systems; safety analysis, increase of reliability and increase of service life of electric power, electrotechnical and electromechanical equipment. <i>Learning purpose:</i> training of specialists capable of designing, designing, operating, ensuring a safety culture, performing installation, commissioning and repair,

	<p>creating new equipment and implementing the latest technologies, conducting research and teaching.</p> <p><i>Theoretical content of the subject area:</i> fundamental knowledge of the theory of electrical engineering, modeling and optimization of electric power, electrotechnical and electromechanical systems and complexes, their use for innovations and researches of operating modes of power stations, networks and systems, electric machines and electric drives.</p> <p><i>Methods, techniques and technologies:</i> methods and means of research of processes in the equipment in electric power and electromechanical systems and complexes, the automated designing, designing and production.</p> <p><i>Tools and equipment:</i> means, devices, systems, technologies of design, operation, control, monitoring.</p>
Orientation OP	Educational and scientific
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 innovation and current areas in which further professional and scientific career is possible: testing and operation of electrical devices; development and implementation of electrotechnological complexes and systems.</p> <p>Key words: electric power industry, electromagnetic compatibility, monitoring, diagnostics, electrotechnical devices, electrotechnological complexes, high - voltage tests, metrological support.</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>Mastering additional fundamental and professionally-oriented disciplines, which together provides the acquisition of the necessary competencies for further professional and scientific activities.</p> <p>The possibility of training foreign students at the Center for International Education KPI. Igor Sikorsky.</p> <p>Carrying out of research practice of students at the enterprises of branch and in scientific establishments.</p>
4 - Suitability of graduates for employment and further study	
Suitability for employment	Graduates are able to hold positions whose qualification requirements include a master's degree in electrical

	<p>engineering, electrical engineering and electromechanics. Graduates can be employed in positions (according to the current Classifier of Professions of Ukraine DK 003: 2010):</p> <p>2143.1 Research Engineer in Agricultural Energy 2143.1 Junior researcher (electrical engineering) 2143.1 Researcher (electrical engineering) 2143.1 Researcher-consultant (electrical engineering) 2143.2 Engineer for operation of emergency automation 2143.2 Engineer of means of dispatching and technological management 2143.2 Engineer of the conversion complex 2143.2 Insulation and surge protection service engineer 2143.2 Engineer of service lines of the energy enterprise 2143.2 Substation Service Engineer 2143.2 Electrical engineer in the energy sector 2143.2 Power Engineer 2143.2 Design engineer (electrical engineering) 2144.2 Engineer for high-voltage tests and measurements of power equipment 2149.2 Research Engineer 2149.2 Design engineer</p>
Further training	Continuation of education at the third (educational and scientific) level of higher education and / or acquisition of additional qualifications in the system of adult 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 complex problems and problems in power engineering, electrical engineering and electromechanics or in the learning process, which involves research and / or innovation and is characterized by uncertainty of conditions and requirements.
General Competences (LC)	3K01. Ability to search, process and analyze information from various sources. 3K02. Ability to use information and communication technologies. 3K03. Ability to apply knowledge in practical situations. 3K04. Ability to use a foreign language to carry out scientific and technical activities. 3K05. Ability to make informed decisions. 3K06. Ability to learn and master modern knowledge. 3K07. Ability to identify and assess risks. 3K08. Ability to work independently and in a team. 3K09. Ability to detect feedback and adjust their actions to suit them. 3K10. Ability to communicate with representatives of

	<p>other professional groups of different levels. 3K11. Ability to abstract thinking, analysis and synthesis.</p>
<p>Professional competencies (FC)</p>	<p>ΦK01. Ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of power engineering, electrical engineering and electromechanics. FK02. Ability to develop and implement measures to improve the reliability, efficiency and safety in the design and operation of equipment and facilities of electricity, electrical engineering and electromechanics. FK03. Ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics. FK04. Ability to demonstrate knowledge and understanding of mathematical principles and methods required for use in power engineering, electrical engineering and electromechanics. ΦK05. Ability to understand and take into account social, environmental, ethical, economic and commercial considerations that affect the implementation of technical solutions in power engineering, electrical engineering and electromechanics. ΦK06. Ability to manage projects and evaluate their results. ΦK07. Ability to develop plans and projects to ensure the achievement of a specific goal, taking into account all aspects of the problem to be solved, including the production, operation, maintenance and disposal of equipment for power, electrical and electromechanical systems. FK08. Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in power engineering, electrical engineering and electromechanics. ΦK09. Ability to use software for computer modeling, computer-aided design, automated production and automated development or design of elements of electrical, electrical and electromechanical systems. FC10. Ability to demonstrate awareness of intellectual property and contracts in power engineering, electrical engineering and electromechanics. FC11. Ability to apply the acquired theoretical knowledge, scientific and technical methods to solve scientific and technical problems and problems of power engineering, electrical engineering and electromechanics. FC12. Ability to plan, organize and conduct research in the field of power engineering, electrical engineering and electromechanics. FC13. Ability to evaluate indicators of reliability and efficiency of operation of electric power, electrotechnical and electromechanical objects and systems. FC14. Ability to research and identify problems and</p>

identify constraints, including those related to nature protection, sustainable development, health and safety, and risk assessments in power engineering, electrical engineering, and electromechanics.

FC15. Ability to apply systematic knowledge on the organization of the pedagogical process in higher education institutions and the use of pedagogical technologies in higher education.

FC16. Ability to ensure electromagnetic compatibility of control systems and implement measures to limit dangerous overvoltages on high-voltage insulation elements of electrical networks of stations and substations.

FC17. Ability to design and develop test and specialized high-voltage transformers and generators of constant high voltage, capacitive high-voltage generators of pulse voltages and pulse currents.

FC18. Ability to introduce comprehensive control of the technical condition of insulation of various high-voltage equipment of the power system, including transformers, reactors, insulators.

FC19. Ability to model by the finite element method and solve problems of calculating the electromagnetic field of electrical devices and electrical equipment using specialized software.

FC20. Ability to perform complete metrological support of experimental measurements of DC, AC and pulse high, ultrahigh and ultrahigh voltages and high currents.

7 - Program learning outcomes

PH01. To reproduce processes in electric power, electrotechnical and electromechanical systems at their computer modeling.

PH02. Outline a plan of measures to improve the reliability, operational safety and life of electrical, electrical and electromechanical equipment and related complexes and systems.

PH03. Analyze the processes in electrical, electrical and electromechanical equipment and related complexes and systems.

PH04. Reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, operational efficiency and resource life.

PH05. Have methods of mathematical and physical modeling of objects and processes in electrical, electrical and electromechanical systems.

PH06. Search for sources of resource support for additional training, research and innovation.

PH07. Plan and implement research and innovative projects in the field of power engineering, electrical engineering and electromechanics.

PH08. Take into account the legal and economic aspects of research and innovation.

PH09. Adhere to the principles and directions of the strategy of development of energy security of Ukraine.

PH10. To substantiate the choice of direction and methods of scientific research taking into account modern problems in the field of electric power, electrical engineering and electromechanics.

PH11. Fluently communicate orally and in writing in state and foreign languages on modern scientific and technical problems of power engineering, electrical engineering and electromechanics.

<p>PH12. Demonstrate an understanding of regulations, norms, rules and standards in the field of power engineering, electrical engineering and electromechanics.</p> <p>PH13. Identify the main factors and technical problems that may hinder the introduction of modern control methods for power, electrical and electromechanical systems.</p> <p>PH14. Master new versions or new software designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems.</p> <p>PH15. Find options to increase energy efficiency and reliability of electrical, electrical and electromechanical equipment and related complexes and systems.</p> <p>PH16. Identify problems and identify constraints related to environmental, sustainable development, human health and safety and risk assessments in the fields of electricity, electrical engineering and electromechanics.</p> <p>PH17. Combine different forms of research and practical activities in order to bridge the gap between theory and practice, scientific achievements and their practical implementation.</p> <p>PH18. Adhere to the principles and rules of academic integrity in educational and scientific activities.</p> <p>PH19. Present research materials at international scientific conferences and seminars on current issues in the field of power engineering, electrical engineering and electromechanics.</p> <p>PH20. To formulate the basic psychological and pedagogical principles and to be able to teach professionally-oriented disciplines in electric power engineering, electrical engineering and electromechanics.</p> <p>PH21. Organize work and coordinate activities to ensure electromagnetic compatibility of technical means at power facilities.</p> <p>PH22. Use modern methods of monitoring and diagnosing the insulation condition of high-voltage electrical equipment in electrical systems and networks, power plants and substations, at alternative energy facilities.</p> <p>PH23. Maintain and operate high-voltage test electrical equipment, measuring equipment, as well as process measurement results.</p> <p>PH24. Model processes in electrotechnological complexes and operation of electrical devices using computer-aided design and calculation systems and application software.</p> <p>PH25. Carry out metrological support of methods and means of measuring DC, AC and pulse high and ultrahigh voltages and high currents.</p>	
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

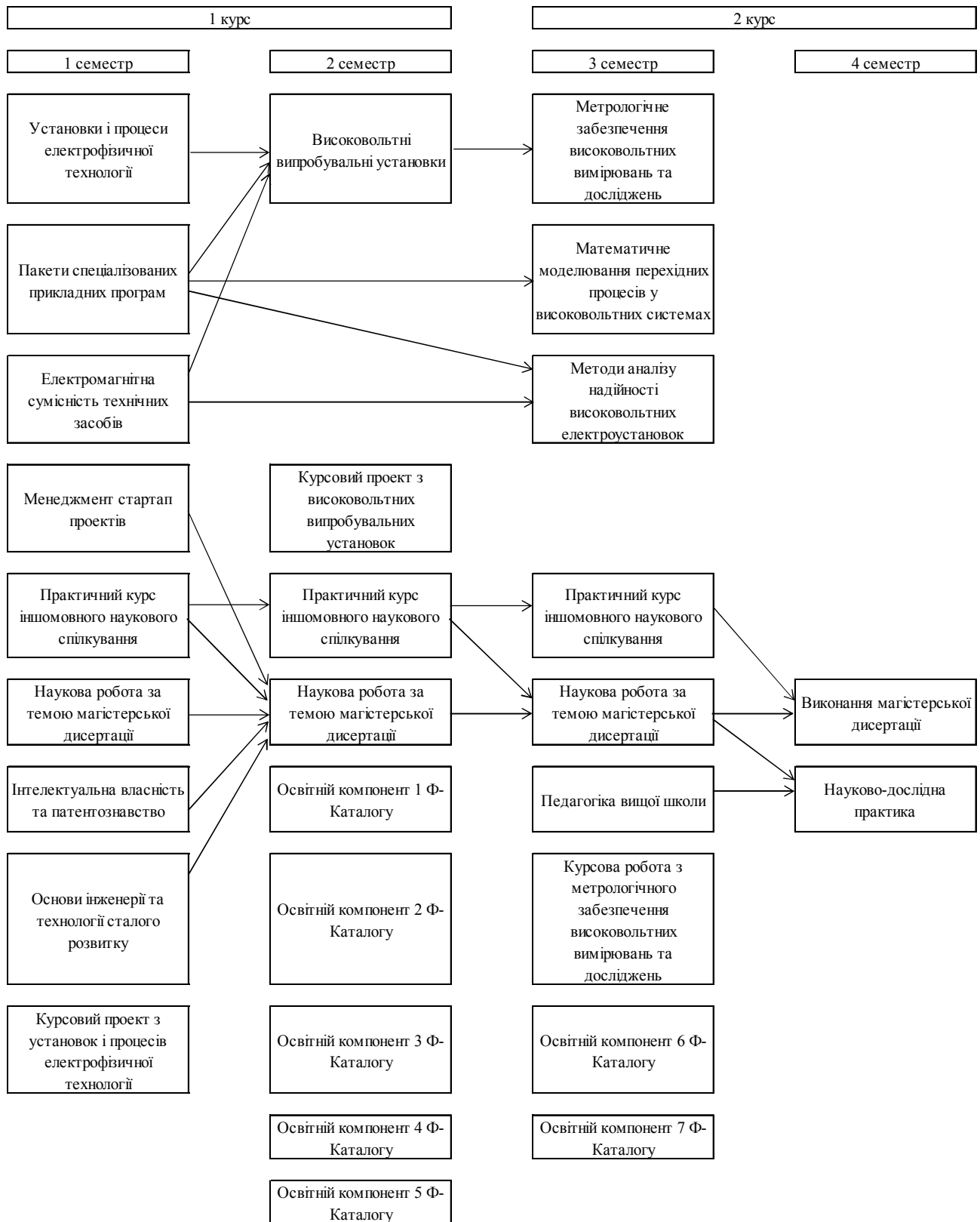
	HE (Annex 5 to the License Terms), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 from 10.05.2018 Use of the Scientific and Technical Library of KPI named after Igor Sikorsky.
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 COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC 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			
General training cycle			
301	Intellectual property and patent science	3	Test
302	Fundamentals of engineering and technology of sustainable development	2	Test
30	Practical course of foreign language scientific communication	4.5	Test
304	Management of startup projects	3	Test

1	2	3	4
3O5	Pedagogy of high school	2	Test
3O6	Mathematical modeling of transients in high-voltage systems	4	Examination
3O7	Methods of analysis of reliability of high-voltage electrical installations	4	Examination
Cycle of professional training			
PO1	Packages of specialized applications	6	Examination
PO2	Installations and processes of electrophysical technology	6	Examination
PO3	High-voltage test rigs	6	Test
PO4	Electromagnetic compatibility of technical means	5	Examination
PO5	Metrological support of high-voltage measurements and researches	3.5	Examination
PO6	Course project on high-voltage test installations	1.5	Test
PO7	Course project on installations and processes of electrophysical technology	1.5	Test
PO8	Course work on metrological support of high-voltage measurements and research	1	Test
PO9	Scientific work on the topic of master's dissertation	10	Test
PO10	Research practice	9	Test
PO11	Completion of a master's dissertation	17	Protection
Selective components of OP			
Cycle of professional training			
PV1	Educational component 1 of the F-Catalog	5	Examination
PV2	Educational component 2 of the F-Catalog	5	Examination
PV3	Educational component 3 of the F-Catalog	5	Examination
PV4	Educational component 4 of the F-Catalog	4	Test
PV5	Educational component 5 of the F-Catalog	4	Test
PV6	Educational component 6 of the F-Catalog	4	Test
PV7	Educational component 7 of the F-Catalog	4	Test
Total amount of compulsory educational components:		89 credits	
The total amount of selective educational components:		31 credits	
TOTAL VOLUME OF THE EDUCATIONAL PROGRAM:		120 credits	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Certification of higher education applicants under the educational-scientific 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 electrical engineering and electromechanics according to the educational program "Electrical devices and electrotechnological complexes".

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. Certification is carried out openly and publicly.

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

	301	302	303	304	305	306	307	ON 1	ON 2	ON 3	ON 4	ON 5	ON 6	ON 7	ON 8	ON 9	ON 10	ON 11
БК01	+	+		+														+
БК02					+													
БК03				+														
БК04			+														+	
БК05				+	+					+			+					
БК06	+	+	+	+	+													
БК07	+	+		+							+							
БК08					+												+	
БК09	+	+		+								+			+			
БК10			+		+											+	+	
БК11																+	+	+
ФК01								+			+					+		+
ФК02									+					+		+	+	
ФК03									+					+			+	
ФК04						+	+	+										+
ФК05		+																+
ФК06				+														
ФК07											+					+		
ФК08	+																	+
ФК09						+		+										
ФК10	+			+														
ФК11																+		+
ФК12																+	+	+
ФК13									+	+	+		+	+		+		
ФК14		+					+					+			+	+		
ФК15					+											+		+
ФК16											+							
ФК17										+			+					
ФК18									+	+	+		+	+				
ФК19								+										
ФК20												+			+			

6. MATRIX OF PROVIDING PROGRAM LEARNING OUTCOMES WITH RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	301	302	303	304	305	306	307	ON1	ON2	ON3	ON4	ON5	ON6	ON7	ON8	ON9	ON10	ON11
PH01						+		+	+	+	+		+	+				+
PH02							+									+		+
PH03						+	+	+										+
PH04																	+	+
PH05						+	+	+										+
PH06	+			+														
PH07	+															+		
PH08	+															+		
PH09		+		+												+		+
PH10																+		+
PH11			+		+													
PH12	+			+							+					+	+	
PH13					+	+			+	+	+		+	+				+
PH14						+	+	+										
PH15									+	+	+		+	+		+		
PH16		+																
PH17																+		
PH18																+		+
PH19																+	+	
PH20			+		+											+	+	
PH21											+							
PH22									+	+	+		+	+				
PH23							+			+		+	+		+			
PH24								+										
PH25												+			+			

Addition

Changes and additions to the educational and scientific program "Electrical devices and electrotechnological complexes" second (master's) level of higher education

At the initiative and suggestions of the guarantor of the educational program, the following changes and additions were made to the updated educational program:

1. The educational components "Intellectual Property and Patent Science" and "Fundamentals of Engineering and Technology for Sustainable Development" were transferred to the first semester.

2. All selected educational components from the F-catalog were removed from the first semester and placed in the second and third as follows: the second - 23 credits, the third - 8 credits totaling 31 credits.

3. Mandatory (normative) components of the educational program "Fundamentals of Engineering and Technology of Sustainable Development", "Practical Course of Foreign Language Scientific Communication" and "Startup Project Management" have been moved to the general training cycle.

4. Due to the formation of the F-catalog and the transfer of selected educational components in the second and third semesters, as well as the allocation of course projects and works in separate educational components, the volume of a number of educational components was redistributed: educational component "Specialized application packages" increased by 1, 5 credits; educational component "High-voltage test facilities" reduced by 3 credits; the educational component "Electromagnetic compatibility of technical means" is reduced by 0.5 credits; the educational component "Metrological support of high-voltage measurements and research" was reduced by 0.5 credits.

5. Appropriate changes have been made to the structural and logical scheme, the matrix of compliance of program competencies with the components of the educational program and the matrix of providing program learning outcomes with the relevant components of the educational program.

Project team leader:

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

Project team members:

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

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

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