

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
“Igor Sikorsky Kyiv Polytechnic Institute”**

APPROVE

Academic Council
of Igor Sikorsky Kyiv Polytechnic Institute
(Meeting protocol No. 3 from March 15, 2021)
Head of Academic Council
Mykhailo ILCHENKO

**Engineering of Intelligent Electrotechnical and
Mechatronic Complexes**

EDUCATIONAL AND SCIENTIFIC PROGRAM

second (master's) level of higher education

specialty	141 Electric Power Engineering, Electrotechnics and Electromechanics
field of knowledge	14 Electrical Engineering
qualification	Master of Electric Power Engineering, Electrotechnics and Electromechanics

Put into effect by the Rector's
Order Igor Sikorsky Kyiv
Polytechnic Institute
from April 19, 2021
No. HOH/89/2021

PREAMBLE

DEVELOPED by a working group:

Chairman of the working group

Rosen Victor, Doctor of Technical Sciences, Professor of the Department
Automation of Electrical and Mechatronic Complexes

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Head of the Department of Automation

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Rosen Victor, Doctor of Technical Sciences, Professor

AGREED:

Scientific and methodical commission of Igor Sikorsky Kyiv Polytechnic Institute
on specialty 141 Electric Power Engineering, Electrotechnics and Electromechanics

Head of Scientific and Methodological commission on specialty 141

Oleksandr YANDULSKYI

(Meeting protocol No. 4 of February 18, 2021)

Methodical council of Igor Sikorsky Kyiv Polytechnic Institute

Chairman of the Methodological Council

Yurii YAKYMENKO

(Meeting protocol № 6 from February 25, 2021)

Educational and scientific program "Engineering of intelligent electrical and mechatronic complexes" of the second (master's) level of higher education has passed external testing and received feedback and reviews from stakeholders: Institute of Electrodynamics of the National Academy of Sciences of Ukraine, National Research Institute of Industrial Safety and Industrial Safety Axion Energy Global Ukraine ", LLC " NTK ENPASELECTRO ", LLC " SV Altera Kyiv ", LLC " Enercis Ukraine ".

The Program takes into account the proposals of stakeholders and professional associations.

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1. DESCRIPTION OF THE EDUCATIONAL PROGRAM

1 – General information	
Full name of the Higher Education Institution and Institute /Faculty	National Technical University of Ukraine "Kyiv Polytechnic Institute named after Igor Sikorsky", Institute of Energy Conservation and Energy Management
Higher education degree and title of qualification in the original language	Degree – Master Qualification - Master of Electric Power Engineering, Electrotechnics and Electromechanics
The official name of the educational program	Engineering of intelligent electrical and mechatronic complexes
Type of diploma and scope of educational program	Master's degree, single, 120 credits, term of study 1 year, 9 months
Availability of accreditation	Accredited for the first time
Level of National Qualifications Framework	NQF of Ukraine - level 7 QF-EHEA – the second cycle EQF-LLL – Level 7
Prerequisites	Having a bachelor's degree
Language (s) of teaching	Ukrainian / English
The duration of the Educational Program	Accredited for the first time
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/ section "Educational programs"
2 – The purpose of the educational program	
<p>Training of a specialist capable of solving complex problems and scientific problems in the power, electrical and electromechanical fields and to carry out innovative professional activities by forming high adaptability in the conditions of labor market transformation through interaction with employers and other stakeholders.</p> <p>The purpose of the educational program corresponds to the development strategy of KPI. Igor Sikorsky for 2020-2025 on the formation of the society of the future on the basis of the concept of sustainable development.</p>	
3 – Characteristics of the educational program	
Subject area	<p>Field of knowledge: 14 - "Electrical Engineering"</p> <p>Specialty: 141 - " Electric Power Engineering, Electrotechnics and Electromechanics "</p> <p><i>Objects of study and activity:</i></p> <ul style="list-style-type: none"> - electrical and electromechanical services of enterprises, scientific and design institutions; - enterprises of the electric power industry, including the fuel and energy complex; - production, transmission, distribution and conversion of electric energy at power plants, electric networks and systems and their engineering; - electrotechnical equipment, electromechanical and switching equipment, electromechanical, electrotechnical complexes, and intelligent control systems. <p><i>The purpose of training: training of specialists capable of designing,</i></p>

	design, operate, ensure safety culture, perform installation, commissioning and repair, create new equipment and implement the latest technologies, conduct research and carry out teaching activities. <i>Theoretical content of the subject area:</i> basic concepts of the theory of electric, electromagnetic circuits and technical mechanics, modeling, optimization and analysis of modes of operation of power plants, networks and systems, electric machines, electric drives, electrotechnical and mechatronic systems and complexes. <i>Methods, techniques and technologies:</i> analytical methods for calculating electrical circuits, power supply systems, electrical machines and devices, intelligent control systems for electrical, electromechanical and mechatronic systems, electrical loads using specialized laboratory equipment, personal computers, microprocessors and programmable logic systems. <i>Tools and equipment:</i> control and measuring devices, electrical and electronic devices, microcontrollers, computers	
Orientation of the educational program	Educational and scientific	
The main focus of the educational program	The program is based on well-known scientific principles, taking into account the current state of development of energy, electrical engineering, electromechanics and mechatronics focuses on current specializations, within which further professional and scientific activities are possible. Keywords: electrotechnical and electromechanical systems and complexes, devices and equipment, control systems, automation systems, engineering.	
Peculiarities of the program	It is possible to use a mixed form of education.	
4 – Eligibility of graduates for employment and further education		
Eligibility for employment	According to the classifier of professions DK003: 2010. Professional certification is possible	
Further training	Continuation of education at the third level of higher education	
5 – Teaching and evaluation		
Teaching and studying	- involvement of specialists from other educational institutions in teaching disciplines; - conducting internships for students in the industry; - participation of higher education applicants in student research circles; - possibility to teach separate courses in English.	
Assessment	According to the rating system, oral and written exams and testing are evaluated	
6 – Program competencies		
Integral competence	Ability to solve complex problems and problems during professional activities in the field of 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 competencies (GC)	GC 1	Ability to abstract thinking, analysis and synthesis.
	GC 2	Ability to search, process and analyze information from various sources.
	GC 3	Ability to use information and communication technologies.
	GC 4	Ability to apply knowledge in practical situations.

	GC 5	Ability to use a foreign language to carry out scientific and technical activities.
	GC 6	Ability to make informed decisions.
	GC 7	Ability to learn and master modern knowledge.
	GC 8	Ability to identify and assess risks.
	GC 9	Ability to work independently and in a team.
	GC 10	Ability to identify feedback and adjust your actions based on them.
Professional competencies (PC)	PC 1	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.
	PC 2	Ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of power engineering, electrical engineering and electromechanics.
	PC 3	Ability to plan, organize and conduct research in the field of power engineering, electrical engineering and electromechanics.
	PC 4	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.
	PC 5	Ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics.
	PC 6	Ability to demonstrate knowledge and understanding of mathematical principles and methods required for use in power engineering, electrical engineering and electromechanics.
	PC 7	Ability to demonstrate awareness of intellectual property and contracts in power engineering, electrical engineering and electromechanics.
	PC 8	Ability to research and identify problems and identify constraints, including those related to nature protection, sustainable development, health and safety and risk assessments in electricity, electrical engineering and electromechanics.
	PC 9	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.
	PC 10	Ability to manage projects and evaluate their results.
	PC 11	Ability to evaluate indicators of reliability and efficiency of operation of electric power, electrotechnical and electromechanical objects and systems.
	PC 12	Ability to develop plans and projects to ensure the achievement of a specific goal, taking into account all aspects of the problem, including the production, operation, maintenance and disposal of equipment for power, electrical and electromechanical systems.

	PC 13	Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in power engineering, electrical engineering and electromechanics.
	PC 14	Ability to use methods of valuation of intellectual property rights for their further commercialization, including for the sale of licenses and technology transfer.
	PC 15	Ability to publish the results of their research in scientific journals.
	PC 16	Ability to formulate technical requirements for developed products and technologies, to determine technical conditions of operation and maintenance of new equipment, to make technical tasks for research and development, to allocate key technological parameters of developments and to define their target or normative values in the field of engineering.
	PC 17	Ability to develop tools, methods and techniques of science and technology aimed at automating existing and creating new automated and automatic technologies and industries.
	PC 18	Ability to create universal most effective algorithms for modeling processes in electrical systems and conduct their research.
	PC 19	Ability to optimize technological processes and build structural diagrams of automated control systems.
	PC 20	Ability on the basis of the analysis of static and dynamic loadings, mode characteristics to calculate and develop optimum designs of the equipment and operational modes of simple and difficult electromechanical complexes with use of modern computer methods of mathematical modeling.
	PC 21	Ability to create new effective methods and techniques for designing, manufacturing, diagnosing and repairing energy-intensive electrical equipment.
	PC 22	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.
	PC 23	Ability to apply the basic tools of innovation management, to form a comprehensive understanding of the problems of innovation management of the enterprise.
	PC 24	Ability to implement educational programs and curricula in accordance with state standards of higher education, as well as to develop and conduct all types of classes and tests in higher education.
	PC 25	Ability to use basic mathematical optimization methods and statistical modeling methods in the development of modern electrical complexes and systems.
	PC 26	Ability to solve complex scientific problems of automation of technological processes using neural networks.
7– Program outcomes of studying		
POS1. Know and understand the main types of intellectual property law and methods of its protection, methodological and legislative bases of creation of intellectual property objects. POS2. Know and understand the main provisions of regulatory documents governing innovation in Ukraine.		

POS3. Know the list of major open international banks of electronic resources to support educational, research and innovation activities.

POS4. Know the basic principles of sustainable development of society, taking into account the social, technological, economic and environmental aspects of human activity.

POS5. Know a foreign language at a level that provides free discussion with foreign scientists on current scientific and technical problems of power engineering, electrical engineering and electromechanics and the opportunity to speak at foreign conferences and symposia.

POS6. Know and understand the current standards, regulations and rules according to which Ukraine conducts activities in the field of electricity, electrical engineering and electromechanics.

POS7. Know and understand the rules of safe operation of electrical, electrical and electromechanical equipment.

POS8. Know the main provisions of the Energy Strategy of Ukraine and the principles of energy security.

POS9. Know the main effective methods and approaches aimed at improving energy efficiency and reliability of electrical, electrical and electromechanical equipment and related complexes and systems.

POS10. Know the basic principles of the latest approaches and modern methods of research in the field of power engineering, electrical engineering and electromechanics.

POS11. To reproduce processes in electric power, electrotechnical and electromechanical systems at their computer modeling.

POS12. Master new versions or new software designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems.

POS13. Reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, operational efficiency and resource life.

POS14. Apply the technique of intelligent control in the study and design of relevant complexes and systems.

POS15. Apply techniques of engineering activities in the field of modern electrical systems.

POS16. Synthesize systems for automatic control of various objects based on the theory of fuzzy logic and using the theory of artificial neural networks.

POS17. To create universal most effective algorithms of modeling of processes of electrotechnical complexes and to carry out their researches on the modern equipment with the modern software.

POS18. Create intelligent-adaptive systems of automated control and monitoring of technical condition by electromechanical equipment based on the use of programmable logic controllers.

POS19. Knowledge of the composition and sequence of development of innovative projects.

POS20. Knowledge, understanding and practical application of experimental theory, methods of experiment planning, evaluation of experimental results, methods of analysis of experimental data and construction of mathematical models based on them, including the use of new methods based on the use of modern information technologies.

POS21. Perform physical and mathematical modeling, static and dynamic analysis of structures, mechanisms, materials and processes at the design stage using modern computer systems.

POS22. Choose the element base of electromechanical and mechatronic systems, complete electric and hydraulic drives, control, protection, automation of power supply systems of machines and installations, production sites and enterprises.

POS23. Create intelligent-adaptive systems of automated control and monitoring of technical condition by electromechanical equipment based on the use of programmable logic controllers and on-board computers.

POS24. Calculate forces, stress-strain state, velocities, moments, power, static and dynamic properties, electromechanical equipment, perform power and hydraulic calculations of hydraulic drive elements, electric drives, linear and nonlinear elements, electric and magnetic circuits.

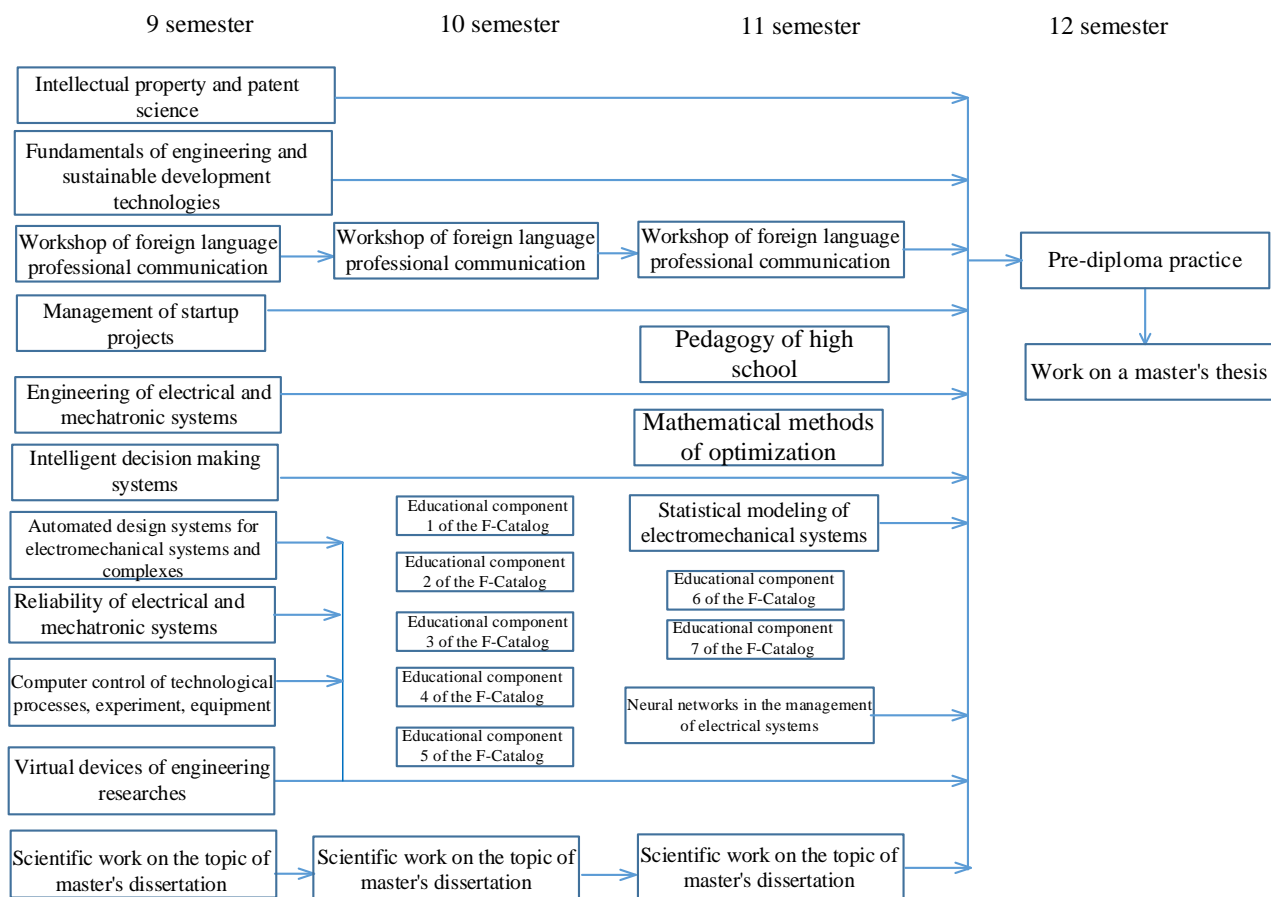
POS25. Fluently communicate orally and in writing in state and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics.

POS26. Identify problems and identify constraints related to environmental, sustainable development, health and safety and risk assessments in the fields of electricity, electrical engineering and electromechanics.	
POS27. Knowledge of basic methods of mathematical optimization and methods of statistical modeling in the development of modern electrical and mechatronic complexes and systems.	
8 – Resource provision of the program’s implementation	
Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the appropriate level, approved by the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015 № 1187 (as amended by the resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018 № 347)
Material-and-technical supplying	In accordance with the technological requirements for material and technical support of educational activities of the appropriate level of HE, approved by the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015 № 1187 (as amended by the resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018 № 347)
Information and methodological supplying	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the relevant level of HE, approved by the Cabinet of Ministers of Ukraine dated December 30, 2015 № 1187 (as amended by the Cabinet of Ministers of Ukraine dated May 10, 2018 № 347)
9 – Academic mobility	
National Credit Mobility	Possibility to conclude agreements on academic mobility, double graduation, etc.
International Credit Mobility	Possibility of concluding agreements on international academic mobility (Erasmus + K1), on double graduation, on long-term international projects that involve the inclusion of students, etc.
Teaching of foreign applicants acquiring higher education	For foreign citizens, education is provided in English, and Ukrainian is studied as a foreign language

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

E/D code	Components of the educational program (disciplines, course projects (works), practices, qualification work)	Number of credits	Final assessment form
1	2	3	4
NORMATIVE educational components			
General training cycle			
GT1	Intellectual property and patent science	3	credit
GT2	Fundamentals of engineering and technology of sustainable development	2	credit
GT3	Workshop of foreign language professional communication	3	credit
GT4	Management of startup projects	3	credit
GT5	Pedagogy of high school	2	credit
GT6	Mathematical methods of optimization	4	exam
Vocational training cycle			
VT1	Statistical modeling of electromechanical systems	4	exam
VT2	Engineering of electrical and mechatronic systems	5	exam
VT3	Intelligent decision making systems	4,5	credit
VT4	Automated design systems for electromechanical systems and complexes	4	exam
VT5	Reliability of electrical and mechatronic systems	4	exam
VT6	Computer control of technological processes, experiment, equipment	4,5	credit
VT7	Virtual devices of engineering researches	4	credit
Research (scientific) component			
VT8	Scientific work on the topic of master's dissertation	7,5	credit
VT9	Pre-diploma practice	9	credit
VT10	Work on a master's thesis	17	defense
VT11	Neural networks in the management of electrical systems	4	credit
SELECTIVE educational components			
Vocational training cycle (Optional subjects from Faculty catalogue)			
VO 1	Educational component 1 from F-Catalog	5	exam
VO 2	Educational component 2 from F-Catalog	4	credit
VO 3	Educational component 3 from F-Catalog	5	exam
VO 4	Educational component 4 from F-Catalog	4	credit
VO 5	Educational component 5 from F-Catalog	5	exam
VO 6	Educational component 6 from F-Catalog	4	credit
VO 7	Educational component 7 from F-Catalog	5	exam
Total scope of normative educational components:		88	
Total scope of selective educational components		32	
TOTAL SCOPE OF THE EDUCATIONAL PROGRAM		120	

3. STRUCTURAL-AND-LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. THE FORM OF GRADUATION CERTIFICATION FOR THE RECIPIENTS OF HIGHER EDUCATION

Certification applicants a higher education professional program "Engineering of intelligent electrical and mechatronic systems" specialty 141 "Electric Power Engineering, Electrotechnics and Electromechanics " takes the form of a public defense of the qualification work and completed delivery of documents form for awarding him the degree of **Master of Electric Power Engineering, Electrotechnics and Electromechanics.**

Qualification work is checked for plagiarism and after the defense is placed in the repository of scientific and technical library University for free access. Graduation certification is open and public.

5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCES TO EDUCATIONAL PROGRAM COMPONENTS

	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6	VT 1	VT 2	VT 3	VT 4	VT 5	VT 6	VT 7	VT 8	VT 9	VT 10	VT 11
GC1										+	+		+				
GC2													+			+	
GC3							+			+			+	+	+	+	
GC4		+						+	+	+		+					
GC5			+							+	+		+				
GC6																+	
GC7				+									+	+			
GC8															+	+	
GC9															+		
GC10	+																
VT1							+				+					+	
VT2							+			+			+		+	+	
VT3							+								+	+	
VT4		+									+						
VT5																	
VT6							+			+	+					+	
VT7	+																
VT8		+															
VT9								+									
VT10								+								+	
VT11								+	+		+						
VT12																+	
VT13										+	+					+	
VT14	+																
VT15										+	+		+			+	
VT16								+					+			+	
VT17	+							+	+	+		+					
VT18							+	+		+	+	+					
VT19									+			+				+	+
VT20							+			+							
VT21										+							
VT22													+			+	+
VT23				+									+				
VT24					+								+				
VT25						+	+					+				+	
VT26													+			+	+

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

	GT 1	GT 2	GT 3	GT 4	GT 5	GT 6	VT 1	VT 2	VT 3	VT 4	VT 5	VT 6	VT 7	VT 8	VT 9	VT 10	VT 11
POS1	+												+				
POS2		+														+	
POS3					+					+			+			+	
POS4		+															
POS5			+							+	+						
POS6										+			+			+	
POS7																+	
POS8							+			+	+		+	+		+	
POS9		+		+							+						
POS10							+			+			+	+		+	+
POS11							+			+		+					+
POS12							+			+		+	+				
POS13											+			+	+	+	
POS14									+								
POS15								+									
POS16				+				+									+
POS17					+	+			+	+		+	+				+
POS18								+		+			+				+
POS19								+	+				+				
POS20							+	+					+				
POS21							+				+						
POS22						+	+	+									
POS23									+								
POS24							+			+							
POS25							+			+	+		+				
POS26													+				
POS27						+	+										