

**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 PROFESSIONAL PROGRAM**

**second (master's) level of higher education**

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

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**

Shevchuk Stepan Prokopovich, Doctor of Technical Sciences, Professor of the Department  
Automation of Electrical and Mechatronic Complexes

### **Members of the working group:**

Mayta Oleksandr, Candidate of Engineering Sciences (Ph.D.),

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Automation of Electrical and Mechatronic Complexes

### **Head of the Department of**

### **Automation of Electrical and Mechatronic Complexes**

**Rozen Viktor**, 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 professional 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: LLC "Axion Energy Global Ukraine", LLC "NTK ENPASELECTRO", Enercis Ukraine LLC.

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

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# 1. DESCRIPTION OF THE EDUCATIONAL PROGRAM

<b>1 – General information</b>	
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, 90 credits, term of study 1 year, 4 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	<a href="https://osvita.kpi.ua/">https://osvita.kpi.ua/</a> section "Educational programs"
<b>2 – The purpose of the educational program</b>	
<p>Training of a specialist capable of solving complex problems and problems in the power, electrical and electromechanical industries 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. 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>	
<b>3 – Characteristics of the educational program</b>	
Subject area	<p><i>Objects of study and activity:</i></p> <ul style="list-style-type: none"> <li>- electrical and electromechanical services of enterprises, scientific and design institutions;</li> <li>- enterprises of the electric power industry, including the fuel and energy complex;</li> <li>- production, transmission, distribution and conversion of electric energy at power plants, electric networks and systems and their engineering;</li> <li>- electrotechnical equipment, electromechanical and switching equipment, electromechanical, electrotechnical complexes, and intelligent control systems.</li> </ul> <p><i>The purpose of training:</i> training of specialists capable of designing, designing, operating, providing a safety culture, performing installation, commissioning and repair, creating new equipment and implementing the latest technologies, conducting research and teaching.</p> <p><i>Theoretical content of the subject area:</i> basic concepts of the theory of electric, electromagnetic circuits and technical</p>

	<p>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.</p> <p><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.</p> <p><i>Tools and equipment:</i> control and measuring devices, electrical and electronic devices, microcontrollers, computers.</p>	
Orientation of the educational program	Educational and professional	
The main focus of the educational program	<p>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.</p> <p>Keywords: electrotechnical, electromechanical and mechatronic systems and complexes, devices and equipment, control systems, intelligent automation systems, engineering.</p>	
Peculiarities of the program	It is possible to use a mixed form of education.	
<b>4 – Eligibility of graduates for employment and further education</b>		
Eligibility for employment	According to the classifier of professions ДК003: 2010. Professional certification is possible	
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.	
<b>5 – Teaching and evaluation</b>		
Teaching and studying	<ul style="list-style-type: none"> <li>- involvement of specialists from other educational institutions in teaching disciplines;</li> <li>- conducting internships for students in the industry;</li> <li>- participation of higher education applicants in student research circles;</li> <li>- possibility to teach separate courses in English.</li> </ul>	
Assessment	Current and semester control in the form of laboratory reports, presentations, essays, written and oral examinations and defense of qualification work are evaluated in accordance with the defined criteria of the Rating system	
<b>6 – Program competencies</b>		
Integral competence	Ability to solve complex problems and problems during professional activities in the field of power engineering, electrical engineering, electromechanics and mechatronics or in the learning process involving research and / or innovation.	
General competencies (GC)	GC1	Ability to abstract thinking, analysis and synthesis.
	GC2	Ability to search, process and analyze information from various sources.
	GC3	Ability to use information and communication technologies.

	GC4	Ability to apply knowledge in practical situations.	
	GC5	Ability to use a foreign language to carry out scientific and technical activities.	
	GC6	Ability to make informed decisions.	
	GC7	Ability to learn and master modern knowledge.	
	GC8	Ability to identify and assess risks.	
	GC9	Ability to work independently and in a team.	
	GC10	Ability to identify feedback and adjust your actions based on them.	
	Professional competencies (PC)	PC1	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.
		PC2	Ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of power engineering, electrical engineering and electromechanics.
		PC3	Ability to plan, organize and conduct research in the field of power engineering, electrical engineering and electromechanics.
PC4		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.	
PC5		Ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics.	
PC6		Ability to demonstrate knowledge and understanding of mathematical principles and methods required for use in power engineering, electrical engineering and electromechanics.	
PC7		Ability to demonstrate awareness of intellectual property and contracts in power engineering, electrical engineering and electromechanics.	
PC8		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.	
PC9		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.	
PC10		Ability to manage projects and evaluate their results.	
PC11		Ability to evaluate indicators of reliability and efficiency of operation of electric power, electrotechnical and electromechanical objects and systems.	

	PC12	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.
	PC13	Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in power engineering, electrical engineering and electromechanics.
	PC14	Ability to use methods of valuation of intellectual property rights for their further commercialization, including for the sale of licenses and technology transfer.
	PC15	Ability to publish the results of their research in scientific journals.
	PC16	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.
	PC17	Ability to develop tools, methods and techniques of science and technology aimed at automating existing and creating new automated and automated technologies and industries.
	PC18	Ability to create universal most effective algorithms for modeling processes in electrical systems and conduct their research.
	PC19	Ability to optimize technological processes and build block diagrams of automated control systems.
	PC20	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.
	PC21	Ability to create new effective methods and techniques for designing, manufacturing, diagnosing and repairing energy-intensive electrical equipment.

#### **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 current standards, regulations and rules according to which Ukraine operates 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 methods 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. Create universal most effective algorithms for modeling the processes of electrical complexes and conduct their research on modern equipment with 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.

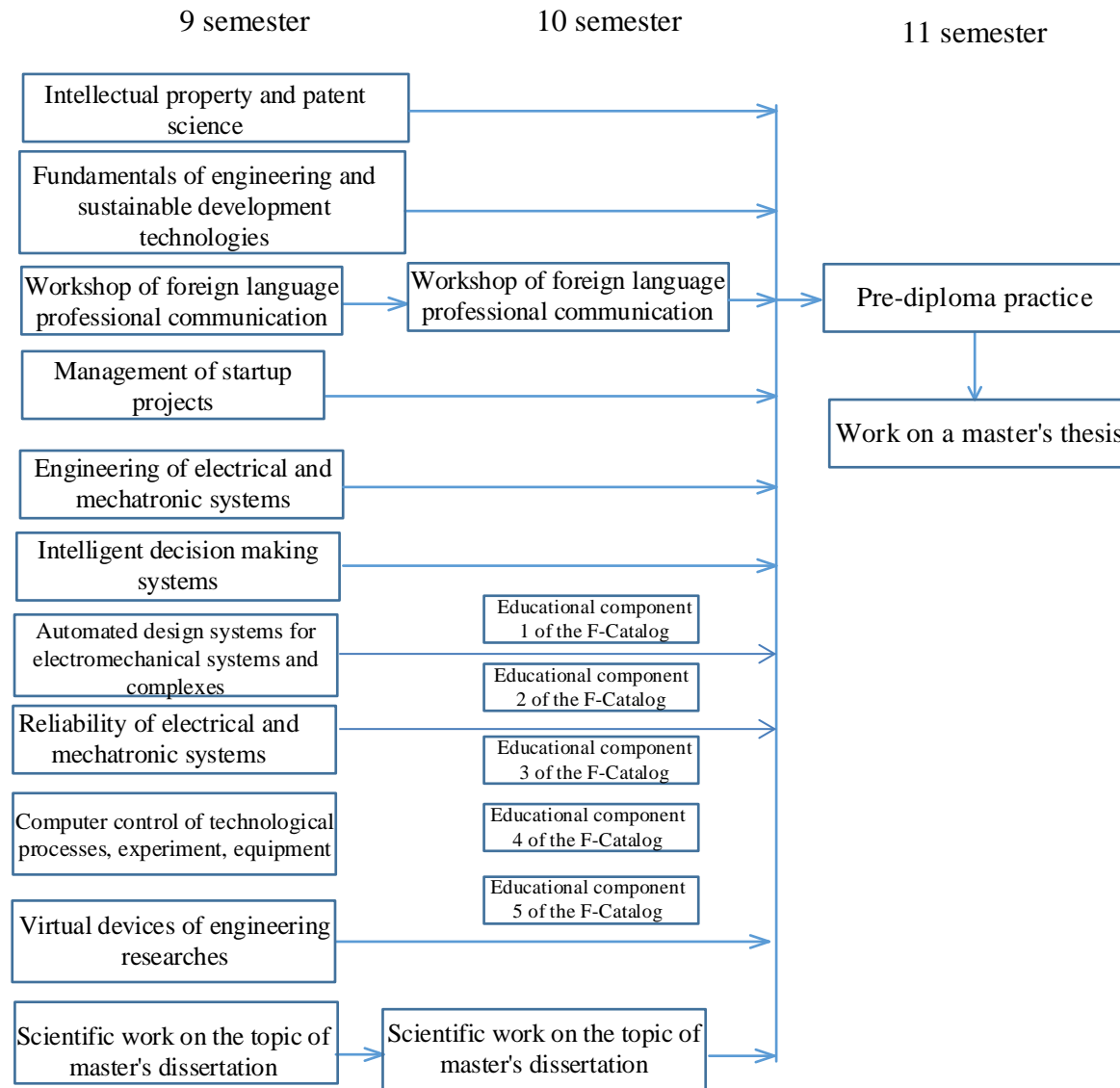


<b>8 – Resource provision of the program’s implementation</b>	
Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the appropriate level, approved by the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015 № 1187 (as amended by the resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018 № 347)
Information and methodological 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)
<b>9 – Academic mobility</b>	
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
<b>NORMATIVE educational components</b>			
<b>General training cycle</b>			
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
<b>Vocational training cycle</b>			
VT1	Engineering of electrical and mechatronic systems	5	exam
VT2	Intelligent decision making systems	4,5	credit
VT3	Automated design systems for electromechanical systems and complexes	4	exam
VT4	Reliability of electrical and mechatronic systems	4	exam
VT5	Computer control of technological processes, experiment, equipment	4,5	credit
VT6	Virtual devices of engineering researches	4	credit
<b>Research (scientific) component</b>			
VT7	Scientific work on the topic of master's dissertation	4	credit
VT8	Pre-diploma practice	14	credit
VT9	Work on a master's thesis	12	defense
<b>SELECTIVE educational components</b>			
<b>Vocational training cycle (Optional subjects from Faculty catalogue)</b>			
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
Total scope of normative educational components::		67	
Total scope of selective educational components:		23	
<b>TOTAL SCOPE OF THE EDUCATIONAL PROGRAM</b>		<b>90</b>	

### 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 " of 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	VT 1	VT 2	VT 3	VT 4	VT 5	VT 6	VT 7	VT 8	VT 9
GC1							+	+		+			
GC2										+			+
GC3							+			+		+	+
GC4		+			+	+	+		+				
GC5			+				+	+		+			
GC6													+
GC7				+						+	+		
GC8												+	+
GC9												+	
GC10	+												
PC1								+					+
PC2							+			+		+	+
PC3												+	+
PC4		+						+					
PC5													
PC6							+	+					+
PC7	+												
PC8		+											
PC9					+								
PC10					+								+
PC11					+	+		+					
PC12													+
PC13							+	+					+
PC14	+												
PC15							+	+		+			+
PC16					+					+			
PC17					+	+	+		+				
PC18					+		+	+	+				
PC19						+			+				
PC20							+						
PC21							+						

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

	GT 1	GT 2	GT 3	GT 4	VT 1	VT 2	VT 3	VT 4	VT 5	VT 6	VT 7	VT 8	VT 9
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										+			