

IT IS RATIFIED

By scientific advice of Igor Sikorsky KPI
(protocol № 4 from April, "2", 2018)

**ELECTROMECHANICAL AUTOMATION SYSTEMS,
ELECTRICAL DRIVE AND ELECTROMOBILITY**

EDUCATIONALLY-SCIENTIFIC PROGRAM

second (master's degree) level of higher education

**after speciality 141 – «Electric energy, electrical engineering
and electromechanics»**

areas of knowledge 14 – «Electric engineering»

**qualification A master's degree in electric energy, electrical
engineering and electromechanics**

Amendments and supplements concertedly
HMKY 141

(protocol № 3 from May, "27" in 2020)

The educational program with changes and
additions is put into effect from 2020/2021. year
of study

(order №1 / 231 of "8" July 2020)

ПРЕАМБУЛА

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За підготовку здобувачів вищої освіти за освітньою програмою відповідає кафедра автоматизації електромеханічних систем та електроприводу.

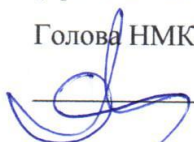
ПОГОДЖЕНО:

Першу редакцію освітньої програми ухвалено Методичною радою КПІ ім. Ігоря Сікорського (протокол № 7 від 29.03.2018 р.)

Зміни та доповнення до освітньої програми погоджені Науково-методичною комісією університету зі спеціальності 141 – «Електроенергетика, електротехніка та електромеханіка»

(протокол № 3 від «27» травня 2020 р.)

Голова НМКУ 141

 Олександр ЯНДУЛЬСЬКИЙ

ВРАХОВАНО:

Зауваження та пропозиції стейкхолдерів за результатами обговорення щодо оновлення освітніх компонент:

- науково-педагогічних працівників кафедри автоматизації електромеханічних систем та електроприводу (протокол №13 від 29 квітня 2020 року);
- здобувачів вищої освіти, які навчаються за освітньою програмою «Електромеханічні системи автоматизації, електропривод та електромобільність»;
- рецензію завідувача відділу перетворення та стабілізації електромагнітних процесів №1 Інституту електродинаміки НАН України, члена-кореспондента НАН України, доктора технічних наук, професора Михальського Валерія Михайловича

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1. EDUCATIONAL PROGRAM PROFILE

from speciality 141 – «Electric energy, electrical engineering and electromechanics»

1 - General information	
Full name of IHE and institute / faculty	A national technical university of Ukraine is the "Igor Sikorsky Kyiv Polytechnic Institute", faculty of electric energy and automations
Higher education degree and title of qualification in the original language	A degree - master's degree Qualification - master's degree from an electric energy, electrical engineering and electromechanics
The official name of the EP	Electromechanical automation systems, electric drive and electromobility
Type of diploma and scope of EP	Master's degree, single, 120 credits, term of study 1 year, 9 months
Availability of accreditation	Certificate ДД № 1192630 (070932) dated 25.09.2017, issued by the Ministry of Education and Science of Ukraine, valid until 01.07.2024.
Cycle/level of HE	NQF of Ukraine - level 8, FQ-EHEA - second cycle, EQF-LLL - level 7
Prerequisites	Having a bachelor's degree
Language(s) of instruction	Ukrainian, English
Validity of the EP	Until the next accreditation
Internet address of the permanent placement of the educational program	https://fea.kpi.ua https://osvita.kpi.ua
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 activities.	
3 - Characteristics of the educational program	
Subject area	<p>Field of knowledge: 14 - "Electrical Engineering"</p> <p>Specialty: 141 - "Electric power, electrical engineering and electromechanics"</p> <p><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;</p> <p>- 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.</p> <p><i>The purpose of training:</i> training of specialists capable of designing, designing, operating, ensuring 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> 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> tools, devices, systems, technologies of design, operation, control, monitoring.</p>
Orientation of EP	Educational and scientific
The main focus of the EP	<p>Special education in the field of power engineering, electrical engineering and electromechanics</p> <p>Key words: electromechanical systems, automated electric drives, electromobility</p>
Features of EP	<ul style="list-style-type: none"> - declared the possibility of training foreign students at the Center for International Education Igor Sikorsky KPI; - the possibility of teaching certain educational components in English; - conducting internships for students in the industry.
4 - Suitability of graduates for employment and further study	
Suitability for employment	<p>Graduates 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 farms engaged in such economic activities (by CEA-2010):</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 Trade in electricity</p> <p>42.22 Construction of electricity and telecommunications facilities</p> <p>43.21 Electrical work</p> <p>71.12 Activities in the field of engineering, geology and geodesy, providing technical consulting services in these areas</p> <p>71.20 Technical tests and research</p> <p>72.19 Research and experimental development on other natural and technical sciences</p> <p>74.90 Other professional, scientific and technical activities</p> <p>85.41 Vocational education at the level of higher vocational education</p> <p>85.42 Higher education</p>

	85.60 Support activities for education Graduates can be employed in positions (according to the current Classifier of Professions of Ukraine SC 003:2010).
Further training	Graduates have the right to continue their education at the third (educational and scientific) level of higher education.
5 - Teaching and assessment	
Teaching and learning	Lectures, practical and seminar classes, computer workshops and laboratory works; course projects and works; technology of blended learning, practice; execution of a master's dissertation
Evaluation	Rating system, assessment, oral and written exams, testing
6 - Program competencies	
Integral competence	Ability to solve complex problems and tasks 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 Competences (GC)	GC1. Ability to search, process and analyze information from various sources. GC2. Ability to use information and communication technologies. GC3. Ability to apply knowledge in practical situations. GC4. Ability to use a foreign language to carry out scientific and technical activities. GC5. Ability to make informed decisions. GC6. Ability to learn and master modern knowledge. GC7. Ability to identify and assess risks. GC8. Ability to work independently and in a team. GC9. Ability to detect feedback and adjust your actions based on them. GC10. Ability to communicate with representatives of other professional groups of different levels. GC11. Ability to abstract thinking, analysis and synthesis.
Professional competencies (PC)	PC1. Ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of power engineering, electrical engineering and electromechanics. PC2. 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. PC3. Ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics. PC4. Ability to demonstrate knowledge and understanding of mathematical principles and methods required for use in power engineering, electrical engineering and electromechanics.

	<p>PC5. 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.</p> <p>PC6. Ability to manage projects and evaluate their results.</p> <p>PC7. 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.</p> <p>PC8. Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in power engineering, electrical engineering and electromechanics.</p> <p>PC9. 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.</p> <p>PC10. Ability to demonstrate awareness of intellectual property and contracts in power engineering, electrical engineering and electromechanics.</p> <p>PC11. 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.</p> <p>PC12. Ability to plan, organize and conduct research in the field of power engineering, electrical engineering and electromechanics.</p> <p>PC13. Ability to evaluate indicators of reliability and efficiency of operation of electric power, electrotechnical and electromechanical objects and systems.</p> <p>PC14. 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.</p> <p>PC15. Ability to publish the results of their research in scientific journals.</p> <p>PC16. Ability to design software and tracking motion control algorithms for electromechanical automation systems and electric drives, to develop optimal and intelligent control laws, to synthesize robust and adaptive automatic control systems.</p> <p>PC17. Ability to perform the synthesis of complex dynamic automatic control systems with incomplete information about state variables, to develop regulators for typical control processes and digital automatic control systems based on microcontrollers.</p> <p>PC18. Ability to solve problems of automation of technical systems using integrated technologies, network interfaces and computer-aided design systems.</p>
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	<p>PC19. Ability to develop electromechanical vehicle automation systems using the latest environmentally friendly technologies.</p> <p>PC20. Ability to apply the basic tools of innovation management, to form a comprehensive understanding of the problems of innovation management of the enterprise.</p> <p>PC21. Ability to use software for computer modeling, automated design, automated production and automated development or design of elements of power, electrical and electromechanical systems</p> <p>PC22. 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 control measures in higher education.</p> <p>PC23. Ability to develop electromechanical vehicle automation systems using the latest environmentally friendly technologies.</p> <p>PC24. Ability to perform research and development work involving the development of new and modernization of existing electromechanical automation systems and electric drives.</p>
7 - Program learning outcomes	
<p>LO01. To reproduce processes in electric power, electrotechnical and electromechanical systems at their computer modeling.</p> <p>LO02. Outline a plan of measures to improve the reliability, operational safety and life of electrical, electrical and electromechanical equipment and related complexes and systems.</p> <p>LO03. Analyze the processes in electrical, electrical and electromechanical equipment and related complexes and systems.</p> <p>LO04. Reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, operational efficiency and resource life.</p> <p>LO05. Have methods of mathematical and physical modeling of objects and processes in electrical, electrical and electromechanical systems.</p> <p>LO06. Search for sources of resource support for additional training, research and innovation.</p> <p>LO07. Plan and implement research and innovative projects in the field of power engineering, electrical engineering and electromechanics.</p> <p>LO08. Take into account the legal and economic aspects of research and innovation.</p> <p>LO09. Adhere to the principles and directions of the strategy of development of energy security of Ukraine.</p> <p>LO10. 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.</p> <p>LO11. Fluently communicate orally and in writing in state and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics.</p> <p>LO12. Demonstrate an understanding of regulations, norms, rules and standards in the field of power engineering, electrical engineering and electromechanics.</p> <p>LO13. Identify the main factors and technical problems that may hinder the introduction of modern control methods for power, electrical and electromechanical systems.</p> <p>LO14. Master new versions or new software designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems.</p> <p>LO15. Find options to increase energy efficiency and reliability of electrical, electrical and</p>	

electromechanical equipment and related complexes and systems.

LO16. Identify problems and identify limitations related to environmental protection, sustainable development, human health and safety, and risk assessments in the fields of electricity, electrical engineering, and electromechanics.

LO17. Combine different forms of research and practical activities in order to bridge the gap between theory and practice, scientific achievements and their practical implementation.

LO18. Adhere to the principles and rules of academic integrity in educational and scientific activities.

LO19. Present research materials at international scientific conferences and seminars on current issues in the field of power engineering, electrical engineering and electromechanics.

LO20. Participate in joint research and development with foreign scientists and specialists in the field of power engineering, electrical engineering and electromechanics.

LO21. To synthesize algorithms of robust and adaptive, vector control, tracking and program control of movement.

LO22. Design fuzzy regulators, neural networks, genetic algorithms, estimators of technological coordinates and parameters for electromechanical control systems of automatic and electric drives.

LO23. Design automation systems using modern software, advanced network technologies and smart panels.

LO24. Develop intelligent automatic control systems, new control algorithms for dynamic systems, perform digital signal processing in electromechanical systems.

LO25. Apply energy-efficient control methods in the development of new electromechanical automation systems and electric drives, electric vehicles.

LO26. Synthesize regulators of complex technological processes using the latest technologies in the field of electromechanics.

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 (current) in the wording dated 23.05.2018 №347.
Logistics	In accordance with the technological requirements for material and technical support of educational activities of the appropriate level of HE (Annex 4 to the License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
Information and educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the appropriate level of HE (Annex 5 to the Licensing Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187

9 - Academic mobility

National credit mobility	Possibility of concluding agreements on academic mobility, double graduation, etc.
International credit mobility	Possibility to conclude agreements on international academic mobility, on double graduation, on long-term international projects that include inclusive student education, etc. International projects: Project Erasmus+ (KD1) with West Pomeranian University of Technology, Szczecin, Poland (West

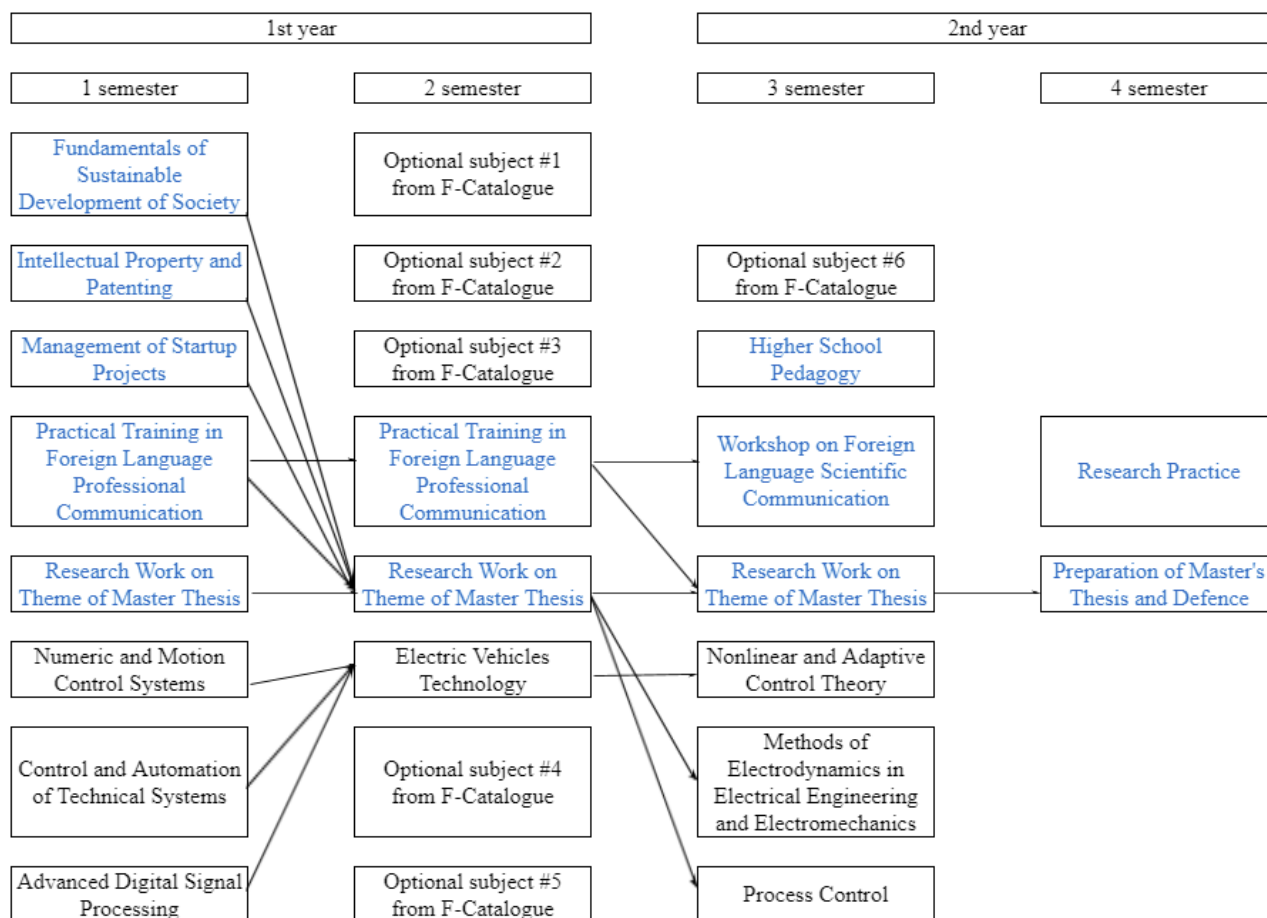
	<p>Pomeranian University of Technology in Szczecin)</p> <p>Project DAAD with the Higher Technical School of Hesse - University of Applied Sciences, Hesse, Germany (Technische Hochschule Mittelhessen - University of Applied Sciences)</p> <p>Project Erasmus+ (KD1) with the University of Lorraine, Min Nancy High School, Nancy, France (Universite de Lorraine Ecole Nationale Superieur des Mines Nancy, ville Nancy, France)</p> <p>Project Erasmus+ (KD1) with Le Mans University, Le Mans, France (Université du Maine, ville Le Mans, France)</p> <p>Project Erasmus+ (KD1) with the University of Applied Sciences in Giessen, Germany (Technische Hochschule Mittelhessen)</p>
Training of foreign applicants HE	Teaching in English

2. LIST OF COMPONENTS OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

Code	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
NORMATIVE components of the EP			
General training cycle			
ZO 1	Intellectual Property and Patenting	3	Credit
ZO 2	Fundamentals of Sustainable Development of Society	2	Credit
ZO 3	Practical Training in Foreign Language Professional Communication	4,5	Credit
ZO 4	Management of Startup Projects	3	Credit
ZO 5	Pedagogy in Higher Education	2	Credit
ZO 6	Methods of Electrodynamics in Electrical Engineering and Electromechanics	4	Credit
ZO 7	Process Control	6	Exam
Vocational training cycle			
PO 1	Numeric and Motion Control Systems	6,5	Exam
PO 2	Control and Automation of Technical Systems	5,5	Exam
PO 3	Electric Vehicles Technology	2,5	Credit
PO 4	Advanced Digital Signal Processing	5	Exam
PO 5	Nonlinear and Adaptive Control Theory	4,5	Exam
PO 6	Courseproject on Electric Vehicles Technology	1,5	Credit
PO 7	Courseproject on Control and Automation of Technical Systems	1,5	Credit
PO 8	Coursework on Nonlinear and Adaptive Control Theory	1	Credit
PO 9	Research Work on Topic of Master's Thesis	7,5	Credit

PO 10	Scientific and Research Practice	9	Credit
PO 11	Preparation of Master's Thesis and Defence	21	Defence MT
ELECTIVE educational components			
Vocational training cycle			
PV 1	Optional subject #1 from F-Catalogue	4	Екзамен
PV 2	Optional subject #2 from F-Catalogue	5	Екзамен
PV 3	Optional subject #3 from F-Catalogue	4,5	Exam
PV 4	Optional subject #4 from F-Catalogue	5	Credit
PV 5	Optional subject #5 from F-Catalogue	4	Credit
PV 6	Optional subject #6 from F-Catalogue	7,5	Exam
TOTAL of NORMATIVE educational components		90 credits	
TOTAL of ELECTIVE educational components		30 credits	
TOTAL		120 credits	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF GRADUATE CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Graduation certification of applicants for higher education in the educational program "Electromechanical automation systems, electric drive and electric mobility" 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. 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 STL of the University for free access. Graduation certification is carried out openly and publicly.

5. MATRIX OF COMPLIANCE OF SOFTWARE COMPETENCIES WITH COMPONENTS OF THE EDUCATIONAL PROGRAM

	ZO 1	ZO 2	ZO 3	ZO 4	Z O 5	Z O 6	Z O 7	PO 1	PO 2	PO 3	PO 4	P O 5	PO 6	PO 7	P O 8	PO 9	PO 10	PO 11
ZK 1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ZK 2	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ZK 3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ZK 4					+	+	+	+	+	+	+	+	+	+	+	+	+	+
ZK 5			+			+	+					+			+		+	+
ZK 6	+			+	+		+	+	+	+	+		+	+		+	+	+
ZK 7	+	+	+	+	+		+	+	+	+	+		+	+		+	+	+
ZK 8	+	+		+	+													
ZK 9					+			+	+	+	+		+	+		+	+	+
ZK 10	+	+			+			+										
FK 1								+	+	+	+		+	+		+	+	+
FK 2								+	+	+	+		+	+		+	+	+
FK 3																+	+	+
FK 4									+	+			+	+		+		
FK 5									+	+			+	+		+		
FK 6		+		+														
FK 7	+			+														
FK 8								+	+	+	+		+	+		+	+	+
FK 9	+			+												+		
FK 10				+														
FK 11									+	+			+	+		+		
FK 12								+	+	+	+		+	+		+	+	+
FK 13									+	+			+	+		+		
FK 14	+															+		
FK 15																+	+	+
FK 16								+	+	+		+			+			
FK 17										+	+	+	+		+			
FK 18									+	+			+	+				
FK 19										+			+					
FK 20	+			+														
FK 21						+	+					+			+			

FK 22					+													
FK 23							+					+			+			
FK 24							+					+			+			

6. MATRIX OF PROVIDING SOFTWARE LEARNING RESULTS BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	ZO 1	ZO 2	ZO 3	ZO 4	Z O 5	Z O 6	Z O 7	PO 1	PO 2	PO 3	PO 4	P O 5	PO 6	PO 7	P O 8	PO 9	PO 10	PO 11
RC 01	+																	
RC 02	+			+														
RC 03	+															+	+	+
RC 04		+																
RC 05			+														+	+
RC 06								+	+	+	+		+	+		+	+	+
RC 07								+	+	+	+		+	+		+	+	+
RC 08	+	+		+														
RC 09								+	+	+	+		+	+		+	+	+
RC 10																+	+	+
RC 11						+	+			+	+	+	+	+	+			
RC 12									+					+				
RC 13						+	+			+	+	+	+	+	+			
RC 14																+	+	+
RC 15				+												+		
RC 16						+	+	+				+			+			
RC 17						+	+	+	+	+	+	+			+			
RC 18						+		+	+	+	+		+	+				
RC 19						+		+	+	+	+		+	+				
RC 20						+												
RC 21																		
RC 22					+													
RC 23						+												
RC 24								+	+	+	+		+	+				
RC 25								+	+	+	+		+	+				
RC 26								+	+	+	+		+	+		+	+	

Addition

Changes and additions to the educational and scientific program
"Electromechanical automation systems, electric drive and electric mobility"
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 Patenting" and "Fundamentals of Sustainable Development of Society" were transferred from the second 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 - 22.5 credits, the third - 7.5 credits with a total amount of 30 credits.

3. Mandatory (normative) components of the educational program "Fundamentals of Sustainable Development of Society", "Practical Training in Foreign Language Professional Communication" and "Management of Startup Projects" have been moved to the general training cycle.

4. In connection with 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 individual educational components, the volume of a number of educational components was redistributed: educational component "Methods of Electrodynamics in Electrical Engineering and Electromechanics" reduced by 1 credit; the educational component "Nonlinear and Adaptive Control Theory" was reduced by 0.5 credits; the educational component "Electric Vehicles Technology" was reduced by 0.5 credits.

5. In the educational component "Control and Automation of Technical Systems" the number of hours of laboratory work was increased from 18 to 27 due to the introduction of new laboratory facilities in the educational process.

6. 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 to the relevant components of the educational program.

Project team leader:

Buryan Serhii Oleksandrovysh, Associate Professor, Candidate of Technical Sciences

Project team members:

Kovbasa Serhii Mykolayovich, associate professor, the doctor of technical sciences

Tolochko Olga Ivanivna, professor, doctor of technical sciences

Korol Serhii Viktorovich, Associate Professor, Candidate of Technical Sciences