

Approved by
Academic Council of
Igor Sikorsky Kyiv Polytechnic Institute

Protocol № 4 since *04.02.2018*

ELECTRIC MACHINES AND APPARATUS

EDUCATIONAL AND SCIENTIFIC PROGRAM

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

Specialty 141 Electric power, electrical engineering and electromechanics

Field of knowledge 14 Electrical engineering

Master's degree in electrical power, electrical engineering and electromechanics

Changes and additions agreed with SMCU 141

Protocol № 3 since *27.05.2020*

The educational program with changes and
additions is put into effect

since 2020/2021 academic year

Order № 1/231 since 08.07.2020

The educational and professional program was developed by the project team

Project team leader

Vasyl Shynkarenko, Doctor of Technical Sciences, Professor, Head of Electromechanics department

Members of the project team

Mykola Reutskiy, PhD, Associate Professor

Sergiy Tsivinskiy, PhD, Associate Professor

The Department of Electromechanics is responsible for the training of applicants for higher education according to the educational and professional program

Agreed:

The first edition of the educational program was approved by the Methodical Commission of the Igor Sikorsky Kyiv Polytechnic Institute (Protocol № 7 since 29.03.2018)

Changes and additions of the educational program was approved by the Scientific and Methodical Commission of the University for Specialty 141 Electric power, electrical engineering and electromechanics

Protocol № 3 since 27.05.2020

The Head of SMCU 141

Oleksandr Yandulsky

Taken into account

Modernization of the educational program is performed on the basis of the approved standard of higher education for Specialty 141 Electric power, electrical engineering and electromechanics (Order of MES № 876 since 20.06.2019)

Proposals of stakeholders in the formation of the EPP are taken into account and confirmed by cooperation agreements between the KPI and “Kvant” Research Institute, G. Petrovskiy Kyiv Automatics Plant, Antonov subsidiary company, Kyiv metro, private joint-stock company “Kyivoblenergo”, private joint-stock company “Kyiv electric car repair plant”, “Construction machinery” subsidiary company, Cascade of Kyiv hydroelectric power plants and hydroaccumulating power plants, Kyiv TPP “Kyivteploenerho”, private joint-stock company “Ventilation systems”, “Diada group” LLC, private enterprise “Scientific and technological center “Reducer”, research and production center “Vertical”, Kremenchug hydroelectric power station.

The requirements of existing and approved standards of Ukraine, requirements for staffing and technological support in accordance with the License Terms approved by the Resolution of the Cabinet of Ministers of Ukraine since 30.12.2015 № 1187, the wishes of students, the results of discussions at meetings of the Electromechanics Department.

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1. PROFILE OF THE EDUCATIONAL PROGRAM

Specialty 141– Electric power, electrical engineering and electromechanics

for the educational and professional program “Electric machines and apparatus”

1 – General information	
Full title of HEI and institute / faculty	National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, Electrical Power engineering and automation departament
Degree of higher education and title of qualification in the original language	Degree – магістр (master) Qualification – магістр з електроенергетики, електротехніки та електромеханіки(Master in electrical power, electrical engineering and electromechanics)
Official title of the educational program	ELECTRIC MACHINES AND APPARATUS
Type of diploma and scope of educational program	Master's degree, single, 120 credits, term of study 1 years 9 months
Availability of accreditation	Accreditation Certificate of ND № 1192558 dated September 25, 2017, issued by the Ministry of Education and Science of Ukraine, valid until July 1, 2023
Cycle / level of HE	NQF of Ukraine – level 8
Precondition	Availability of bachelor’s degree
Language (s) of teaching	Ukrainian/English
Valid date of the educational program	Until next accreditation
Internet address of the permanent placement of the educational program	http://em.fea.kpi.ua/images/doc_stud/opp_m_emsemetsk.pdf http://osvita.kpi.ua/index.php/op
2 – The purpose of the educational program	
Training of a specialist capable of solving complex problems and problems in the field of electrical power, electrical engineering and electromechanics industries and to carry out innovative professional activities	

3 – Characteristics of the educational program	
Subject area	<p>Specialty 141 Electric power, electrical engineering and electromechanics</p> <p>Field of knowledge 14 Electrical engineering</p> <p>Objects of study and activity: 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.</p> <p>Purpose of study: training of specialists capable of designing, designing, operating, ensuring safety culture, performing installation, commissioning and repair, creating new equipment and implementing the latest technologies, conducting research and teaching.</p> <p>Theoretical content of the subject area: 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>Methods, techniques and technologies: methods and means of research of processes in equipment in electric power and electromechanical systems and complexes, automated design, design and production.</p> <p>Tools and equipment: tools, devices, systems, technologies of design, engineering and monitoring.</p>
Orientation of the educational program	Educational and scientific
The main focus of the educational program and specialization	<p>Special education in the field of power engineering, electrical engineering and electromechanics</p> <p>Keywords: electromechanical systems, automated electric drives, electric machines, electrical devices, electrotechnical devices, electrotechnological complexes</p>
Features of the program	<p>Involvement of specialists from other educational institutions in teaching disciplines.</p> <p>Conducting internships for students in the industry.</p> <p>The possibility of teaching certain courses in English.</p>
4 – Suitability of graduates for employment and further education	
Suitability for employment	<p>Specialists are able to hold positions, the qualification requirements of which include a master's degree in electrical engineering, electrical engineering and electromechanics, in business entities engaged in the following types of economic activity (according to the classifier of economic activities types-2010):</p> <p>35.11 Electricity generation</p> <p>35.12 Transmission of electricity</p> <p>35.13 Distribution of electricity</p> <p>71.12 Activities in the field of engineering, geology and geodesy,</p>

	providing technical consulting services in these areas 71.20 Technical tests and research 72.19 Research and experimental development on other natural and technical sciences 74.90 Other professional, scientific and technical activities 85.41 Vocational education at the level of higher vocational education 85.42 Higher education 85.60 Support activities for education According to the classifier of professions DK 003: 2010 specialists can perform the different types of professional work, including scientific, research and teaching types. Professional certification is possible
Further education	Graduates have the right to continue their studies at the third (educational and scientific) level of higher education
5 – Teaching and evaluation	
Teaching and learning	Lectures, practical and seminar classes, computer workshops and laboratory work, course projects and works, technology of blended learning, practices and excursions, master's dissertation.
Evaluation	Rating system, oral and written exams, testing.
6 – Program competencies	
Integral competence	Ability to solve complex problems and problems of professional activity in the field of electrical engineering and electromechanics, which involves research of electrical and electromechanical complexes and the implementation of innovations which are characterized by uncertainty of conditions and requirements
General competencies (3K)	
3K 1	Ability to abstract thinking, analysis and synthesis of electromechanical complexes and electric machines
3K 2	Ability to search, process and analyze information from various sources
3K 3	Ability to use information and communication technologies
3K 4	Ability to apply knowledge in practical situations with electromechanical complexes and electric machines
3K 5	Ability to use a foreign language to carry out scientific and technical activities
3K 6	Ability to make informed decisions about problems with electromechanical complexes and electric machines
3K 7	Ability to learn and master modern knowledge
3K 8	Ability to identify and assess risks
3K 9	Ability to work independently and in a team
3K 10	Ability to identify feedback and adjust your actions based on them
Professional competencies of the specialty (ΦK)	
ΦK 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

ФК 2	Ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of power engineering, electrical engineering and electromechanics
ФК 3	Ability to plan, organize and conduct research in the field of power engineering, electrical engineering and electromechanics
ФК 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
ФК 5	Ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics
ФК 6	The ability to think modernly on the basis of the concept of sustainable development of society
ФК 7	Ability to identify intellectual property rights
ФК 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
ФК 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
ФК 10	Ability to evaluate indicators of reliability and efficiency of operation of electric power, electrotechnical and electromechanical objects and systems
ФК 11	Ability to develop plans and projects to ensure the achievement of the 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
ФК 12	Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in power engineering, electrical engineering and electromechanics
ФК 13	Ability to use methods of valuation of intellectual property for their further commercialization, including for the sale of licenses and technology transfer
ФК 14	Ability to publish the results of their research in scientific journals
ФК 15	Ability to identify, obtain and place the necessary data, plan and conduct analytical and experimental research and modeling of electrical machines and devices, critically evaluate data and draw conclusions
ФК 16	Ability to model and study with the help of modern software and hardware electromagnetic fields of electric machines and devices
ФК 17	Ability to effectively use new technologies in the process of modernization and reconstruction of electrical equipment, electrical machines and devices, electric transport, electrical devices, systems and complexes

ФК 18	Ability to develop plans and projects to ensure the achievement of the 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
ФК19	Ability to develop physical and mathematical models of the studied machines, drives, systems, processes, phenomena and objects in the professional sphere, to develop methods and organize experiments with the analysis of results
ФК20	Ability to set system problems of research using the technology of structural prediction and methodology of innovative synthesis for arbitrary classes of electromechanical objects
ФК21	Ability to use modern software products for modeling and solving problems of calculating electromagnetic and thermal fields of electric machines and devices
ФК22	Ability to use new technologies, participate in the modernization and reconstruction of electromechanical equipment, electrical machines and apparatus, electric transport, electromechanical devices, systems and complexes
ФК23	Ability to develop physical, mathematical and information models of studied electrical machines, electromechanical objects, systems, physical processes and phenomena in the professional sphere, to develop methods and organize experiments with analysis of results
7 – Program learning outcomes (ПР)	
ПР01	To know the basic types of intellectual property rights and methods of their protection, methodological and legislative bases of creation of intellectual property objects
ПР02	To know the main provisions of regulatory documents governing innovation in Ukraine
ПР03	Use the list of major open international banks of electronic resources to provide support for educational, research and innovation activities
ПР04	Understand the principles of sustainable development of society taking into account the social, technological, economic and environmental aspects of human activity
ПР05	Know a foreign language at a level that provides free discussion with foreign scientists on current scientific and technical issues of power engineering, electrical engineering and electromechanics and the opportunity to speak at scientific conferences and symposia
ПР06	Know the current standards, regulations and rules according to which Ukraine operates in the field of electricity, electrical engineering and electromechanics
ПР07	Use the rules of safe operation of electrical, electrical and electromechanical equipment
ПР08	Know the provisions of the Energy Strategy of Ukraine and the principles of energy security
ПР09	Have effective methods and approaches aimed at improving energy efficiency and reliability of electrical, electrical and electromechanical equipment and related complexes and systems
ПР10	Have the latest approaches and modern methods of research in the field of power engineering, electrical engineering and electromechanics

ПР11	Have modern methods of mathematical modeling of objects and processes in electrical, electrical and electromechanical systems
ПР12	Use modern software packages designed to create computer models of objects and in-depth study of processes in electrical, electrical and electromechanical systems
ПР13	Know the theory of large systems, systems analysis and mathematical methods used to solve optimization problems in the field of power systems
ПР14	Use the methods of optimal planning and conducting experiments, methods of processing and evaluating the results of experimental research using modern information technology, current standards and requirements for the preparation of reports on research work
ПР15	Know the composition and sequence of development of innovative projects
ПР16	To use analytical methods of determination and numerical methods of calculation of process parameters in electric power, electrotechnical and electromechanical equipment, its complexes and systems
ПР17	Know the principles of effective management of production and research activities with the involvement of innovative approaches and technologies
ПР18	To know the legal and regulatory framework that determines the activities in the field of higher education in Ukraine, methodology and techniques, classical and innovative technologies of higher education
ПР19	Have modern techniques, algorithms and software for calculation and design of electrical machines and devices
ПР20	Know the design features, technical characteristics, principles of operation and modes of operation of electromechanical devices, electrical machines and devices, including powerful turbo and hydro generators
ПР21	Know modern methods of system, physical and mathematical modeling of electrical machines and devices, electromechanical energy converters, electromechanical complexes
ПР22	Have modern approaches and methods for solving problems of interdisciplinary analysis and synthesis of new, competitive objects of electromechanics
ПР23	Find options to increase energy efficiency and reliability of electrical, electrical and electromechanical equipment and related systems
ПР24	To reproduce processes in electric power, electrotechnical and electromechanical systems at their computer modeling
ПР25	Master new versions or new software designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems
ПР26	Outline a plan of measures to improve the reliability, operational safety and life of electrical, electrical and electromechanical equipment and related complexes and systems

ПР27	Analyze the processes in electrical, electrical and electromechanical equipment and related complexes and systems
ПР28	Reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, operational efficiency and resource life
ПР29	Take into account the legal and economic aspects of research and innovation
ПР30	Present research materials at international scientific conferences and seminars on current issues in the field of power engineering, electrical engineering and electromechanics
ПР31	Analyze the processes in electrical, electrical and electromechanical equipment and related complexes and systems
ПР32	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
ПР33	Plan and implement research and innovation projects in the field of power engineering, electrical engineering and electromechanics
ПР34	Combine different forms of research and practical activities in order to bridge the gap between theory and practice, scientific achievements and their practical implementation
ПР35	Fluently communicate orally and in writing in state and foreign languages on modern scientific problems of power engineering, electrical engineering and electromechanics
ПР36	Identify problems and identify constraints related to environmental protection, sustainable development, human health and safety and risk assessments in the fields of electricity, electrical engineering and electromechanics
ПР37	Identify the main factors and technical problems that may hinder the introduction of modern control methods for power, electrical and electromechanical systems
ПР38	Identify the problems facing society and which can be solved by using and adhering to the principles of sustainable development of society
ПР39	Search for sources of resource support for additional training, research and innovation

ПР40	Choose methods of mathematical and physical modeling of objects and processes in electrical, electrical and electromechanical systems
ПР41	Organize and manage the cognitive activity of students, form in them critical thinking and the ability to carry out educational activities with all its components
ПР42	Identify problems, perform formulation and solution of search problems, including problems of prediction and directed synthesis of competitive electromechanical objects for a given synthesis function
ПР43	Perform electromagnetic and thermal calculations, design electrical machines, devices and electromechanical devices using modern software products
ПР44	Monitor and diagnose electrical and electromechanical equipment and facilities, establish the main causes of failure during operation
ПР45	Investigate physical phenomena and processes in electrical machines and devices, electromechanical energy converters, electromechanical complexes
ПР46	Integrate patent information and structural-system research as a basis for determining the technical level, innovation potential, structural foresight and development of competitive technical solutions based on them
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 (Annex 2 to the License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine since 30.12.2015 № 1187
Material and technical support	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 since 30.12.2015 № 1187
Informational, 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 License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine since 30.12.2015 № 1187
9 – Academic mobility	
National credit mobility	Possibility of concluding agreements on academic mobility, double graduation, etc.

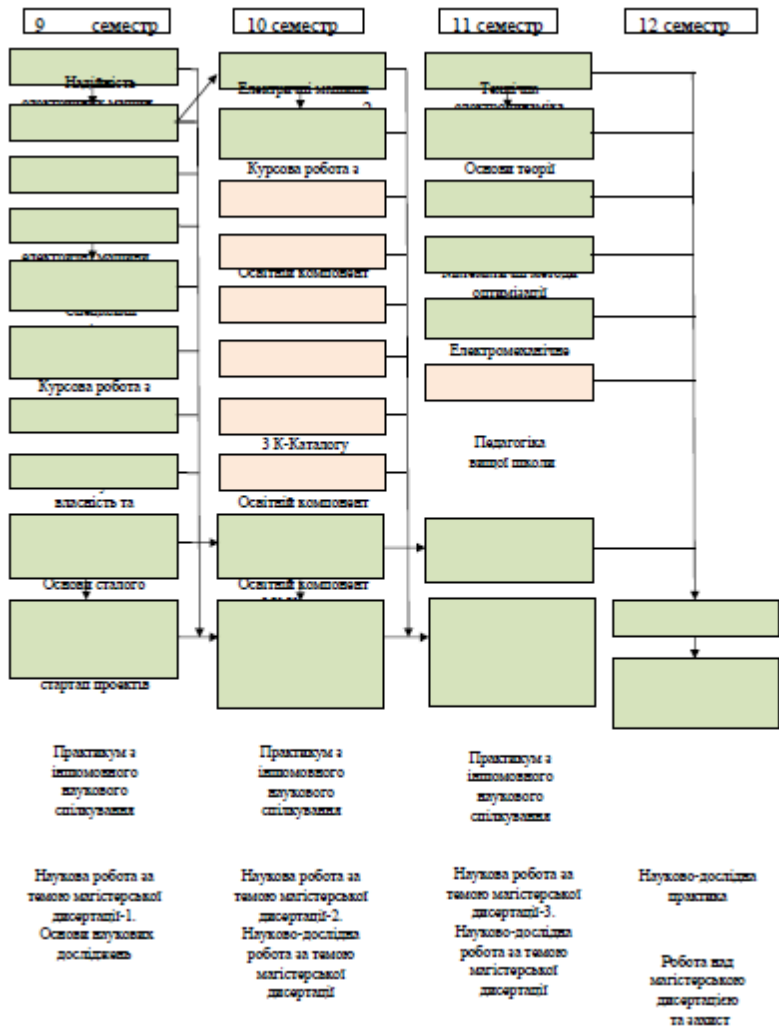
International credit mobility	<p>It is possible to conclude agreements on international academic mobility, on double graduation, on long-term international projects that include inclusive student education, etc.</p> <p>International projects:</p> <p>Erasmus + project (KA1) with West Pomeranian University of Technology in Szczecin, Poland</p> <p>DAAD project with Hessen University of Applied Sciences, University of Applied Sciences, Hesse, Germany (Technische Hochschule Mittelhessen - University of Applied Sciences)</p> <p>Erasmus + project (KA1) with the University of Lorraine, Minc Nancy, Nancy, France (Universite de Lorraine Ecole Nationale Superieur des Mines Nancy, ville Nancy, France)</p> <p>Erasmus + project (KA1) with the University of Le Mans, Le Mans, France</p> <p>Erasmus + project (KA1) with the University of Applied Sciences Giessen, Germany (Technische Hochschule Mittelhessen)</p>
Teaching foreign applicants for higher education	Teaching in English

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (academic disciplines, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
Normative EP components			
General training cycle			
3O 1	Intellectual property and patent science	3	Test
3O 2	Fundamentals of sustainable development of society	2	Test
3O 3	Workshop on foreign language professional communication	4,5	Test
3O 4	Startup project management	3	Test
3O 5	Pedagogy of high school	2	Test
3O 6	Methods of mathematical optimization	4	Test
3O 7	Electromechanical energy conversion	4	Exam
Cycle of professional training			
ПО 1	Technical electrodynamics	4	Exam
ПО 2	Fundamentals of the theory of electromechanical structures	3,5	Exam
ПО 3	Reliability of electric machines	6	Exam
ПО 4	Traction electric machines	4	Exam

1	2	3	4
ПО 5	Special electric machines	4	Exam
ПО 6	Course work with Special electric machines	1	Test
ПО 7	Electric machines of automation systems	6,5	Exam
ПО 8	Course work with Electric machines automation systems	1	Test
ПО 9	Scientific work on the topic of master's dissertation	7,5	Test
ПО 10	Pre-diploma practice	9	Test
ПО 11	Diploma project	21	Defence
Elective EP components			
Cycle of professional training			
ПВ 1	Educational component 1 K- Catalogue	6	Exam
ПВ 2	Educational component 2 K- Catalogue	3,5	Test
ПВ 3	Educational component 3 K- Catalogue	3	Test
ПВ 4	Educational component 4 K- Catalogue	4	Exam
ПВ 5	Educational component 5 K- Catalogue	3	Test
ПВ 6	Educational component 6 K- Catalogue	3	Test
ПВ 7	Educational component 7 K- Catalogue	7,5	Test
Total amount of normative components :		90	
Total amount of elective components :		30	
The amount of educational components that ensure the acquisition of competencies defined by the HES		120	
TOTAL AMOUNT OF THE EDUCATIONAL PROGRAM		120	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF FINAL CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Graduation certification of applicants for higher education in the educational program "Electric Machines and Apparatus" specialty 141 "Electric power, Electrical Engineering and Electromechanics" is conducted in the form of defense of the qualification work (master's dissertation) and ends with the issuance of a standard document on awarding a Master's degree in electrical power, electrical engineering and electromechanics.

Graduation certification is carried out openly and publicly.

Qualification work is checked for the absence of academic plagiarism, fabrication and falsification and after the defense is placed in the repository of the Igor Sikorsky KPI NTL for free access.

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

[illegible]

6. MATRIX FOR PROVIDING RELEVANT SOFTWARE LEARNING OUTCOMES

	SO 1	SO 2	SO 3	SO 4	SO 5	SO 6	SO 7	IO 1	IO 2	IO 3	IO 4	IO 5	IO 6	IO 7	IO 8	IO 9	IO 10	IO 11	IO 1	IO 2	IO 3	IO 4	IO 5	IO 6	IO 7
IP 1	+																								
IP 2	+	+																							
IP 3	+	+	+																						
IP 4				+	+	+																			
IP 5			+																						
IP 6																									
IP 7																									
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IP 30		+																							
IP 31																									
IP 32		+																							
IP 33	+																								
IP 34		+																							

	SO 1	SO 2	SO 3	SO 4	SO 5	SO 6	SO 7	IO 1	IO 2	IO 3	IO 4	IO 5	IO 6	IO 7	IO 8	IO 9	IO 10	IO 11	IO 1	IO 2	IO 3	IO 4	IO 5	IO 6	IO 7
IP 35																									
IP 36																									
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IP 45																									
IP 46																									

Changes and additions to the educational-professional program

ELECTRIC MACHINES AND APPLIANCES

The second (master's) level of higher education

1. Changes in curricula according to the requirements of the educational department of the department of the educational department of KPI named after Igor Sikorsky are taken into account:

- The educational components "Patent Science and Intellectual Property" and "Fundamentals of Sustainable Development of Society" were postponed to the first semester.
- All elective educational components from the F-catalog were removed from the first semester and placed in the second semester in the amount of 22.5 credits.
- The components of the educational program "Fundamentals of Sustainable Development of Society", "Practical Course of Foreign Language Scientific Communication" and "Startup Project Management" have been transferred from the category of general elective disciplines of the general training cycle to the category of general compulsory disciplines.
- Two course works are allocated in separate educational components, accordingly the volume of each of two disciplines Special electric cars and Electric cars of automation systems is reduced by one credit.

2. Made changes to the structural logical schemes: provided a transcript of each discipline, changed the links between them

3. The matrix of correspondence of program competences to components of the educational program and a matrix of maintenance of program results of training by the corresponding components of the educational program are corrected.

The educational and professional program was developed by the project team

Project team leader

Vasyl Shynkarenko, Doctor of Technical Sciences, Professor

Members of the project team

Mykola Reutskiy, PhD, Associate Professor

Sergiy Tsivinskiy, PhD, Associate Professor