

Approved by
Academic Council of
Igor Sikorsky Kyiv Polytechnic Institute

Protocol № 5 since 30.06.2020

The Head of Academic Council

Mikhailo Ilchenko

ELECTRIC MACHINES AND APPARATUS

EDUCATIONAL AND PROFESSIONAL PROGRAM of the first (bachelor's) level of higher education

Specialty 141 Electric power, electrical engineering and electromechanics

Field of knowledge 14 Electrical engineering

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

*Put into effect by order of the Rector of
Igor Sikorsky Kyiv Polytechnic Institute*

Order № 1/231 since 08.07.2020

KYIV 2020

The educational and professional program was developed by the project team

Project team leader

Anna Shymanska, PhD, Associate Professor

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 with the Scientific and Methodical Commission of the Igor Sikorsky Kyiv Polytechnic Institute for Specialty 141 Electric power, electrical engineering and electromechanics

The Head of SMCU 141

Oleksandr Yandulsky

Protocol № 3 since 27.05.2020

The Head of Methodical Council

Yiriy Yakimenko

Protocol № 10 since 18.06.2020

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 proposals of external stakeholders to provide an in-depth level of professional English and study of Comsol multiphysics, Mathcad, Archicad applied engineering programs are taken into account.

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.

The proposals of internal stakeholders to provide distance learning courses with high-quality content posted on the distance education platform "Sikorsky" and to provide teaching of certain disciplines in English for domestic students are taken into account.

CONTENT

1. Profile of the educational program	4
2. List of components of the educational program	9
3. Structural and logical scheme of the educational program	11
4. Form of final certification of applicants for higher education	12
5. Matrix of correspondence of program competences to components educational program	13
6. Matrix for providing relevant software learning outcomes components of the educational program	14

1. PROFILE OF THE EDUCATIONAL PROGRAM

Specialty 141– Electric power, electrical engineering and electromechanics

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 – бакалавр (bachelor) Qualification – бакалавр з електроенергетики, електротехніки та електромеханіки (Bachelor 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	Bachelor's degree, single, 240 credits, term of study 3 years 10 months
Availability of accreditation	Accreditation Certificate of ND № 1192558 (070862) 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 7
Precondition	Availability of complete general secondary education
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_emsemetk.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	Objects of study and activity: enterprises of the electric power complex, electrotechnical and electromechanical services of organizations, production, transmission, distribution and conversion of electric energy at electric power stations, in electric networks and systems, electrotechnical equipment, electromechanical and switching equipment, electromechanical and electrotechnical complexes and systems/ The purpose of study is the training of specialists capable of solving specialized problems and practical problems of power engineering, electrical engineering and electromechanics, which involves the application of theories and methods of physics and engineering and is characterized by complexity and uncertainty of conditions. Theoretical content of the subject area: basic concepts theory of electric and electromagnetic circuits, modeling, optimization and analysis of power plant operation modes, networks and systems, electric machines, electric drives, electrical and electromechanical systems and complexes using traditional and renewable energy sources. Methods, techniques and technologies: analytical methods calculation of electrical circuits, power supply systems, electrical machines and devices, control systems electrical and electromechanical systems, electrical loads using specialized laboratory equipment, personal computers and other equipment. Tools and equipment: control and measuring tools, electrical and electronic devices, microcontrollers, computers.
Orientation of the educational program	Educational and professional
The main focus of the educational program and specialization	Special education in the field of power engineering, electrical engineering and electromechanics Keywords: electromechanical systems, automated electric drives, electric machines, electrical devices, electrotechnical devices, electrotechnological complexes
Features of the program	Implemented in English for foreign students
4 – Suitability of graduates for employment and further education	
Suitability for employment	According to the classifier of professions ДК003: 2010 graduates can perform various types of professional work Professional certification is possible
Further education	Graduates have the right to continue their studies at the second (master's) level of higher education

5 – Teaching and evaluation	
Teaching and learning	The general style of study is student-oriented. Teaching is carried out in the form of: lectures, seminars, practical classes, laboratory classes in small groups (up to 8 people), independent work with the possibility of consultation with the teacher, individual classes, course projects and work, qualification work; application of information and communication technologies (e-learning, online lectures, distance learning courses) for individual educational components. All participants in the educational process are provided with timely and understandable information on the goals, content and program learning outcomes, the procedure and evaluation criteria within the individual educational components.
Evaluation	Current and semester control in the form of laboratory reports, modular tests, testing, presentations, written and oral examinations and defense of qualification work are evaluated in accordance with the defined criteria of the Rating system
6 – Program competencies	
Integral competence	Ability to solve complex specialized problems and practical problems in the field of power engineering, electrical engineering and electromechanics or in the learning process, which involves the application of certain theories and methods of relevant science and is characterized by complexity and uncertainty of conditions
General competencies (3K)	
3K 1	Ability to apply knowledge in practice
3K 2	Ability to communicate in the state language both orally and in writing
3K 3	Ability to communicate in a foreign language
3K 4	Ability to use information and communication technologies
3K 5	Ability to search, process and analyze information from various sources
3K 6	Ability to identify problems, form tasks and solve problems
3K 7	Ability to make informed decisions
3K 8	Willingness and ability to perform work with high quality both independently and collectively and to make decisions within their professional knowledge and competencies
3K 9	Ability to communicate with representatives of other professional groups of different levels
3K 10	The ability to act socially responsibly and consciously
Professional competencies of the specialty (ΦK)	
ΦK 1	Ability to solve practical problems with the involvement of computer-aided design and calculation (CAD) systems
ΦK 2	Ability to solve practical problems with the involvement of higher mathematics, general physics and theoretical electrical engineering
ΦK 3	Ability to solve practical problems related to the operation of electrical systems and networks, electrical part of stations and substations

ФК 4	Ability to solve practical problems related to the problems of metrology, electrical measurements, the operation of automatic control devices, relay protection and automation
ФК 5	Ability to solve practical problems related to the operation of electric machines, devices and automated electric drive
ФК 6	Ability to solve practical problems related to the problems of production, transmission and distribution of electricity
ФК 7	Compliance with the requirements of standards, norms and specifications for the design of electrical, electrical and electromechanical equipment.
ФК 8	Compliance with the requirements of the rules of safety, labor protection and norms of industrial sanitation at the enterprises of electric power and electromechanical complexes
ФК 9	Mastering the application software for modeling the modes of operation of electrical, electrical and electromechanical equipment
ФК 10	Awareness of the need to increase energy efficiency of electrical, electrical and electromechanical equipment
ФК 11	Awareness of the need to constantly expand their knowledge about new technologies in power engineering, electrical engineering and electromechanics
ФК 12	Emergency preparedness in electric power and electromechanical systems
ФК 13	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 14	Ability to model and study with the help of modern software and hardware electromagnetic fields of electric machines and devices
ФК 15	Ability to perform thermal calculations of electrical machines and transformers, perform their modeling and analysis
ФК 16	Ability to perform calculations of the mechanical part of electrical machines and devices, mechanical transients, calculate the parameters of electrical machines and devices, perform their modeling and analysis
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 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
ФК19	Awareness of the need to increase the efficiency of electrical, electrical and electromechanical equipment
ФК20	Awareness of the need to constantly expand their knowledge of new technologies in power engineering, electrical engineering and electromechanics

ΦK21	Ability to promptly take effective measures in emergency (emergency) situations in power and electromechanical systems
ΦK22	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
ΦK23	Ability to model and study with the help of modern software and hardware electromagnetic fields of electric machines and devices
ΦK24	Ability to perform thermal calculations of electrical machines and transformers, perform their modeling and analysis
ΦK25	Ability to perform calculations of the mechanical part of electrical machines and devices, mechanical transients, calculate the parameters of electrical machines and devices, perform their modeling and analysis
ΦK26	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
ΦK27	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
7 – Program learning outcomes (ΠΡ)	
ΠΡ01	To know and understand the principles of electrical systems and networks, power equipment of power plants and substations, protective earthing and lightning protection devices and be able to use them to solve practical problems in professional activities
ΠΡ02	To know and understand the theoretical basis of metrology and electrical measurements, the principles of automatic control devices, relay protection and automation, have the skills to perform appropriate measurements and use these devices to solve professional problems.
ΠΡ03	To know the principles of operation of electrical machines, devices and automated electric drives and be able to use them for solving practical problems in professional activities
ΠΡ04	To know the principles of operation of bioenergy, wind, hydro and solar power plants
ΠΡ05	To know the basics of the theory of the electromagnetic field, methods of calculating electric circuits and be able to use them to solve practical problems in professional activities
ΠΡ06	To use application software, microcontrollers and microprocessor technology to solve practical problems in professional activities
ΠΡ07	To carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems
ΠΡ08	To select and apply suitable methods for analysis and synthesis of electromechanical and electric power systems with specified parameters

ПР09	To be able to evaluate the energy efficiency and reliability of electrical, electrical and electromechanical systems
ПР10	To find the necessary information in the scientific and technical literature, databases and other sources of information, assess its relevance and reliability
ПР11	To communicate freely on professional problems in the state and foreign languages orally and in writing, to discuss the results of professional activity with specialists and non-specialists, to argue their position on debatable issues
ПР12	To understand the basic principles and objectives of technical and environmental safety of electrical and electromechanical objects, take them into account when making decisions
ПР13	Modern techniques, algorithms and software for calculation, design, manufacture, installation, operation, fault diagnosis and repair of electrical machines and devices
ПР14	To understand the principles of European democracy and respect for rights citizens, take them into account when making decisions
ПР15	To understand and demonstrate good professional, social and emotional behavior, follow a healthy lifestyle
ПР16	To know the requirements of regulations relating to engineering, protection of intellectual property, labor protection, safety and industrial sanitation, take them into account when making decisions
ПР17	To solve complex specialized problems in the design and maintenance of electromechanical systems, electrical equipment of power plants, substations, systems and networks
ПР18	To be able to learn independently, master new knowledge and improve skills of work with modern equipment, measuring equipment and application software
ПР19	To apply suitable empirical and theoretical methods to reduce losses of electric energy during its production, transportation, distribution and use
ПР20	To apply modern methods of mathematical modeling of electrical machines and devices, electromechanical energy converters, electromechanical complexes
ПР21	To apply modern methods of experimental research of electric machines and devices, electromechanical energy converters, electromechanical complexes
ПР22	To understand the features of design, technical characteristics, principles of operation and modes of operation of electromechanical devices, electrical machines and apparatus, including powerful turbo and hydrogenerators
ПР23	To be able to perform tasks on maintenance of electromechanical systems, electrical equipment of power plants, substations, systems and networks
ПР24	To be able to monitor and diagnose electrical and electromechanical equipment and facilities, to establish the main causes of failure during their operation, to study physical phenomena and processes in electrical machines and devices, electromechanical energy converters, electromechanical complexes

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

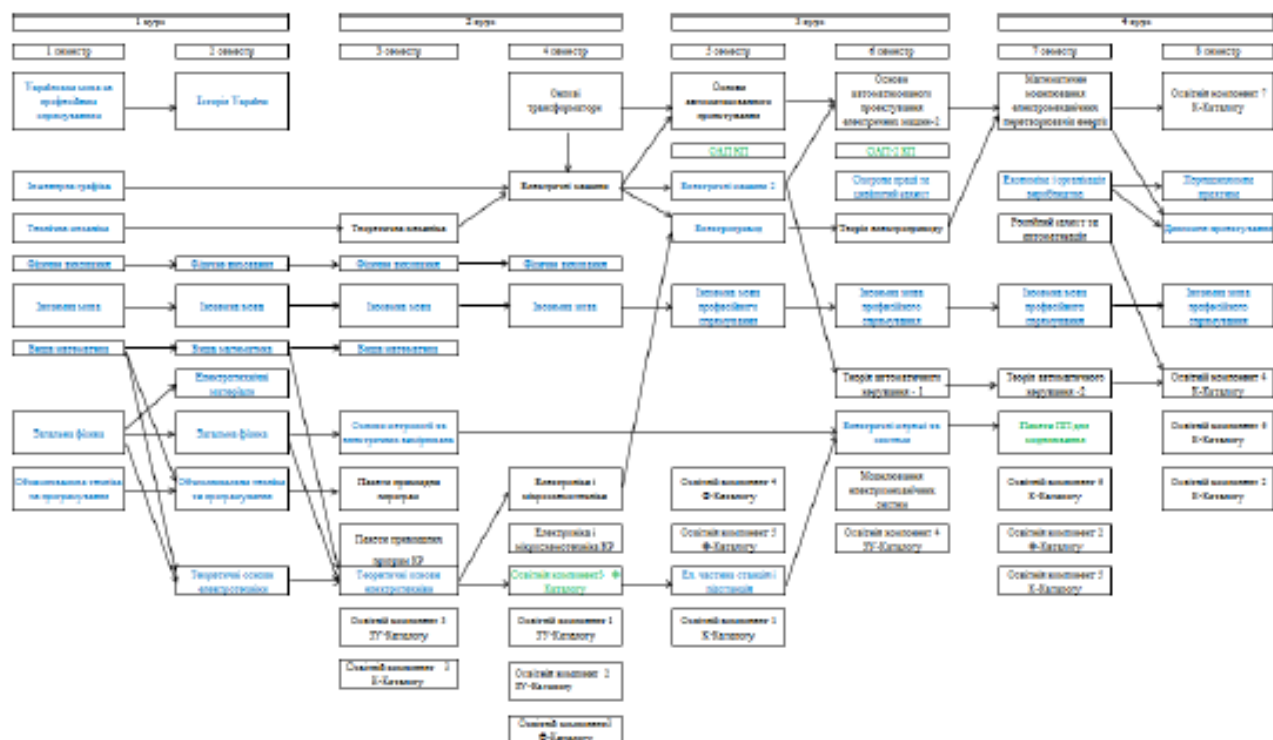
2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

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			
30 1	Ukrainian language for professional purposes	2	Test
30 2	History of Ukraine	2	Test
30 3	Physical Education	5	Test

1	2	3	4
30 4	Foreign Language	6	Test
30 5	Economics and production organization	3	Test
30 6	Fundamentals of Labor safety and civil defence	4	Test
30 7	Higher mathematics	18	Exam
30 8	General Physics	9	Exam
30 9	Computing and programming	12	Exam
30 10	Engineering graphics	3	Test
30 11	Technical mechanics	3	Test
30 12	Electrical materials	3	Test
30 13	Fundamentals of metrology and electrical measurements	4	Exam
30 14	Theoretical foundations of electrical engineering	10	Exam
30 15	Electric machines	6	Exam
30 16	Electrical equipment of electric power stations and substations	4	Exam
30 17	Electric drive	4	Exam
30 18	Electrical networks and systems	6	Exam
30 19	Relay protection and automation of power systems	4	Test
Cycle of professional training			
ПО 1	Theoretical mechanics	6	Test
ПО 2	Power transformers	3	Test
ПО 3	Electric machines 2	8,5	Exam
ПО 4	Theory of automatic control	8	Exam
ПО 5	Fundamentals of automated design of electrical machines	7	Exam
ПО 6	Theory of electric drive	3	Test
ПО 7	Modeling of electromechanical systems	4	Exam
ПО 8	Mathematical modeling of electromechanical energy converters	4	Exam
ПО 9	Application packages for the design of electrical machines	4	Test
ПО 10	Application packages for modeling electric machines	3	Test

1	2	3	4
ПО 11	Electronics and microcircuits	4,5	Exam
ПО 12	Course work on Electronics and microcircuits	1	Test
ПО 13	Course project on the Fundamentals of automated design of electrical machines -1 (Designing of transformer)	1,5	Test
ПО 14	Course project on the Basics of automated design of electric machines -2 (Designing of induction motor)	1,5	Test
ПО 15	Course work on Application packages for the design of electrical machines	1	Test
ПО 16	Pre-diploma practice	6	Test
ПО 17	Diploma project	6	Defence
Elective EP components			
General training cycle			
3B 1	Educational component 1 3Y- Catalogue	2	Test
3B 2	Educational component 2 3Y- Catalogue	2	Test
3B 3	Educational component 3 3Y- Catalogue	2	Test
3B 4	Educational component 4 3Y- Catalogue	2	Test
3B 5	Foreign language for professional purposes	2	Exam
Cycle of professional training			
ПВ 1	Educational component 1 Φ- Catalogue	6	Exam
ПВ 2	Educational component 2 Φ- Catalogue	4	Exam
ПВ 3	Educational component 3 Φ- Catalogue	2,5	Test
ПВ 4	Educational component 4 Φ- Catalogue	2	Test
ПВ 5	Educational component 5 Φ- Catalogue	2,5	Test
ПВ 6	Educational component 1K- Catalogue	3	Test
ПВ 7	Educational component 2K- Catalogue	4	Exam
ПВ 8	Educational component 3K- Catalogue	3	Test
ПВ 9	Educational component 4K- Catalogue	4	Exam
ПВ 10	Educational component 5K- Catalogue	3,5	Test
ПВ 11	Educational component 6K- Catalogue	8	Test
ПВ 12	Educational component 7K- Catalogue	3,5	Test
Total amount of normative components :		180	
Total amount of elective components :		60	
The amount of educational components that ensure the acquisition of competencies defined by the HES		240	
TOTAL AMOUNT OF THE EDUCATIONAL PROGRAM		240	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF FINAL CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Certification is carried out in the form of public defense of the qualification project (qualification work).

The qualification project (qualification work) should provide for the solution of a complex specialized task or practical problem of electric power industry,

electrical engineering and / or electromechanics, characterized by the complexity and uncertainty of conditions, using theories and methods of electrical engineering.

The qualification project (qualification work) must not contain academic plagiarism, fabrication and falsification.

The qualification project (qualification work) must be posted on the website of the higher education institution or its structural subdivision, or in the repository of the higher education institution.

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

[illegible]

6. MATRIX FOR PROVIDING RELEVANT SOFTWARE LEARNING OUTCOMES

[illegible]

