MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
UKRAINIAN STATE UNIVERSITY OF RAILWAY TRANSPORT

APPROVED

Protocol of meeting of the Academic Council of the Ukrainian State University of Railway Transport from June 4, 2020 № 4

(Edited after viewing. Protocol of meeting of the Academic Council of the Ukrainian State University of Railway Transport from ___ _____ 2021 № ___)

Put into action
from the 2021/2022 academic year

Rector

_____ Sergii PANCHENKO

EDUCATIONAL PROFESSIONAL PROGRAM

ELECTRIC TRANSPORT

Level of higher education:	first
Degree of higher education:	bachelor
Field of knowledge:	14 Electrical Engineering
Specialty:	141 Electrical Energetics, Electrical Engineering and Electromechanics

Kharkiv − 2021

1. Preamble

The Law of Ukraine "On Higher Education" provides that:

1) educational-professional program – a single set of educational components (disciplines, individual tasks, practices, control measures, etc.) aimed at achieving the results of such a program, which gives the right to obtain certain educational or educational and professional qualifications;

2) the standard of higher education defines the following requirements for the educational program:

the amount of ECTS credits required to obtain an appropriate higher education degree;

requirements for the level of education of persons who can start training under this program and the results of their training;

a list of required graduate competencies;

normative content of training of applicants for higher education, formulated in terms of learning outcomes;

forms of certification of applicants for higher education;

requirements for the creation of educational training programs in the field of knowledge, two branches of knowledge or a group of specialties (in the standards of the junior bachelor's level), interdisciplinary educational and scientific programs (in the standards of master and doctor of philosophy);

requirements of professional standards (if any);

3) the educational program must contain:

list of educational components, their logical sequence;

requirements for the level of education of persons who can start training under this program;

the number of ECTS credits required to complete this program, as well as the expected program learning outcomes (competencies) that must be mastered by the higher education applicant;

4) higher education institution on the basis of the relevant educational program develops a curriculum that defines the list and scope of educational components in ECTS credits, their logical sequence, forms of organization of the educational process, types and scope of classes, schedule, forms of current and final control. achievement by the applicant of the corresponding degree of higher education of program results of training. On the basis of the curriculum in the order determined by the institution of higher education for each applicant of higher education individual curricula for each academic year are developed and approved.

Educational and professional program "Electric Transport" in the editorial office after viewing:

1) developed on the basis of the Standard of higher education of the first (bachelor's) level in the specialty 141 Electrical Energetics, Electrical Engineering and Electromechanics of knowledge 14 Electrical Engineering, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated 20.06.2019 № 867, the working group of the Department of Electrical Energetics, Electrical

Engineering and Electromechanics of the Ukrainian State University of Railway Transport consisting of:

NERUBATSKYI Volodymyr Pavlovych	–	Associate Professor of Department of Electrical Energetics, Electrical Engineering and Electromechanics, PhD, Associate Professor, project team leader (guarantor of the educational program);
PLAKHTII Olexandr Andrievych	–	Associate Professor of Department of Electrical Energetics, Electrical Engineering and Electromechanics, PhD, member of the project team;
SEMENENKO Olexandr Ivanovych	–	Associate Professor of Department of Electrical Energetics, Electrical Engineering and Electromechanics, PhD, Associate Professor, member of the project team;

involving and taking into account the positions and needs of such stakeholders:

TOMASHEVSKYI Roman Serhievych	–	Director of the Educational and Scientific Institute of Energy, Electronics and Electromechanics National Technical University "Kharkiv Polytechnic Institute"
TUGAI Dmytro Vasilievych	–	Head of the Department of Alternative Electrical Energetics and Electrical Engineering O. M. Beketov National University of Urban Economy in Kharkiv
ANAKIN Eugene Olexandrovych	–	Director of the Limited Liability Company «VO OVEN» (Kharkiv)
VERENKO Lyubov Ihorivna	–	4th year student of the first (bachelor's) level of the educational program "Electric Transport" specialty 141 Electrical Energetics, Electrical Engineering and Electromechanics

2) approved at the meeting:

Department of Electrical Energetics, Electrical Engineering and Electromechanics from January 4, 2021 (protocol № 6);

carried out methodical examination PhD, Associate Professor Logvinenko O. A.;

scientific and methodical commission of the Faculty of Mechanical and Energy from ___ _____ 2021 (protocol № ___);

Academic Council of the Faculty of Mechanical and Energy from ___ _____ 2021 (protocol № ___);

3) approved at a meeting of the Academic Council of the Ukrainian State University of Railway Transport from ___ _____ 2021 (protocol № ___).

2. Profile of the educational and professional program "Electric transport"

2.1. General characteristics

Level of higher education	The first (bachelor's) level
Degree of higher education	Bachelor
Branch of knowledge	14 Electrical Engineering
Specialty	141 Electrical Energetics, Electrical Engineering and Electromechanics
Restrictions on forms of education	There are no restrictions
Educational qualification	Bachelor of Electrical Energetics, Electrical Engineering and Electromechanics with the educational program Electric Transport
Qualification in the diploma	Degree of higher education – Bachelor Specialty – 141 Electrical Energetics, Electrical Engineering and Electromechanics Educational program – Electric Transport
Description of the subject area	**Objects of study:** – enterprises of the electric power complex, electrotechnical and electromechanical services of organizations; – production, transmission, distribution and conversion of electricity at power plants, power grids and systems; electrotechnical equipment, electromechanical and switching equipment, electromechanical and electrotechnical complexes and systems. **The purpose of training:** training of specialists capable of solving specialized problems and practical problems of electric power, 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** includes: basic concepts of the theory of electric and electromagnetic circuits, modeling, optimization and analysis of modes of operation of power plants, networks and systems, electric machines, electric drives, electrical and electromechanical systems and complexes using traditional and renewable energy sources. **Methods, techniques, approaches and technologies:** analytical methods for calculating electrical circuits, power supply systems, electrical machines and apparatus, control

	systems for electrical and electromechanical systems, electrical loads using specialized laboratory equipment, personal computers and other equipment. **Tools and equipment:** control and measuring devices, electrical and electronic devices, microcontrollers, computers.
Academic and professional rights of graduates	Opportunity to continue studying at the second (master's) level of higher education. Acquisition of additional qualifications in the system of postgraduate education, advanced training.
Number of semesters / years of study	8 / 4 (6 / 3)

2.2. Requirements for the level of education of persons who can start training in the educational-professional program: availability of complete general secondary education, junior bachelor's degree (junior specialist's educational qualification level).

2.3. Number of ECTS credits required to complete the educational-professional program is 240 ECTS credits.

At least 50 percent of the educational program should be aimed at providing general and special (professional) competencies in the educational-professional program (specialty), defined by the standard of higher education in the specialty 141 Electrical Energetics, Electrical Engineering and Electromechanics branches of knowledge 14 Electrical Engineering, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated 20.06.2019 № 867.

The amount of free choice of students must be at least 25 percent of the total number of ECTS credits provided by the educational program.

2.4. Expected program learning outcomes (competencies) to be mastered by the higher education applicant

1	**Integral competence**	Ability to solve specialized problems and solve practical problems during professional activities in the field of power engineering, electrical engineering and electromechanics or in the learning process, which involves the application of theories and methods of physics and engineering and are characterized by complexity and uncertainty, including railway, urban and industrial electric transport.	
2	**General competencies**	GC 01	Ability to abstract thinking, analysis and synthesis.
		GC 02	Ability to apply knowledge in practical situations.
		GC 03	Ability to communicate in the state language both orally and in writing.
		GC 04	Ability to communicate in a foreign language.
		GC 05	Ability to search, process and analyze information from various sources.
		GC 06	Ability to identify, pose and solve problems.
		GC 07	Ability to work in a team.
		GC 08	Ability to work autonomously.
		GC 09	Ability to exercise one's rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine.
		GC 10	Ability to preserve and increase moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, techniques and technologies. active recreation and a healthy lifestyle.
3	**Special (professional) competencies**	PC 01	Ability to solve practical problems using computer-aided design and calculation systems.
		PC 02	Ability to solve practical problems involving methods of mathematics, physics and electrical engineering.
		PC 03	Ability to solve complex specialized problems and practical problems related to the operation of electrical systems and networks, electrical part of stations and substations and high voltage equipment.

		PC 04	Ability to solve complex specialized problems and practical problems related to the problems of metrology, electrical measurements, the operation of automatic control devices, relay protection and automation.
		PC 05	Ability to solve complex specialized problems and practical problems related to the operation of electric machines, devices and automated electric drive.
		PC 06	Ability to solve complex specialized problems and practical problems related to the problems of production, transmission and distribution of electricity.
		PC 07	Ability to develop projects of electrical energetics, electrotechnical and electromechanical equipment with observance of requirements of the legislation, standards and the technical task.
		PC 08	Ability to perform professional duties in compliance with the requirements of safety, labor protection, industrial sanitation and environmental protection.
		PC 09	Awareness of the need to increase the efficiency of electrical energetics, electrotechnical and electromechanical equipment.
		PC 10	Awareness of the need to constantly expand their knowledge about new technologies in the electrical energetics, electrotechnical and electromechanical.
		PC 11	Ability to promptly take effective measures in emergency situations in electrical energetics and electromechanical systems.

SR 01. Know and understand the principles of operation 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.

SR02. Know and understand the theoretical foundations 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.

SR 03. Know the principles of operation of electric machines, devices and automated electric drives and be able to use them to solve practical problems in professional activities.

SR 04. Know the principles of operation of bioenergy, wind, hydro and solar energetics plants.

SR 05. 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.

SR 06. Use application software, microcontrollers and microprocessor technology to solve practical problems in professional activities.

SR 07. Carry out analysis of processes in electrical, electrical and electromechanical equipment, relevant complexes and systems.

SR 08. Select and apply suitable methods for analysis and synthesis of electromechanical and electric power systems with specified parameters.

SR 09. Be able to assess the energy efficiency and reliability of electrical, electrical and electromechanical systems.

SR 10. Find the necessary information in the scientific and technical literature, databases and other sources of information, assess its relevance and reliability.

SR 11. Communicate freely on professional issues in state and foreign languages orally and in writing, discuss the results of professional activities with specialists and non-specialists, argue their position on debatable issues.

SR 12. Understand the basic principles and objectives of technical and environmental safety of electrical and electromechanical objects, take them into account when making decisions.

SR 13. Understand the importance of traditional and renewable energy for successful economic development of the country.

SR 14. Understand the principles of European democracy and respect for the rights of citizens, take them into account in decision-making.

SR 15. Understand and demonstrate good professional, social and emotional behavior, follow a healthy lifestyle.

SR 16. Know the requirements of regulations relating to engineering, intellectual property protection, labor protection, safety and industrial sanitation, take them into account when making decisions.

SR 17. Solve complex specialized problems in the design and maintenance of electromechanical systems, electrical equipment of power plants, substations, systems and networks.

SR 18. Be able to learn independently, acquire new knowledge and improve skills in working with modern equipment, measuring equipment and application software.

SR 19. Apply suitable empirical and theoretical methods to reduce electricity losses during its production, transportation, distribution and use.

The correspondence of learning outcomes and competencies is shown in table 1, the correspondence of learning outcomes and educational components – in table 2.

3. The list of educational components and their logical sequence

№ s/n	Educational component	Number of ECTS credits	Duration of study (in semesters)	Form of final control
1. CYCLE OF GENERAL TRAINING				
ES 01	History of Ukraine and Ukrainian culture	4	1	Examination
ES 02	Ukrainian language	3	1	Examination
ES 03	Philosophy	3	1	Examination
ES 04	Economics and organization of production	3	1	Examination
ES 05	Jurisprudence	3	1	Test
ES 06	Foreign language	5	2	Examination
ES 07	Physical education		4	Test
ES 08	Higher mathematics	15	3	Examination
ES 09	Descriptive geometry and engineering graphics	8	2	Examination
ES 10	Computer technology and programming	7	2	Examination
ES 11	Physics	9	2	Examination
ES 12	Theoretical mechanics	7	2	Examination
ES 13	Applied mechanics	4	1	Examination
ES 14	Course work on the discipline "Applied mechanics"	–	–	Protection
ES 15	Theoretical foundations of electrical engineering	11	2	Examination
ES 16	Ecology in a professional direction	3	1	Test
ES 17	Fundamentals of metrology and electrical measurements	3	1	Test
ES 18	Electric machines	7	2	Examination
ES 19	Course work on the discipline "Electric machines"	–	–	Protection
	The volume of normative educational components	**95.0**	–	–

Disciplines of free choice of the student of a cycle of general preparation				
FC 01	Discipline 1**	3	1	*
FC 02	Discipline 2**	3	1	*
FC 03	Discipline 3**	3	1	*
FC 04	Discipline 4**	3	1	*
	The amount of selective educational components	**12.0**	–	–
	The total amount of educational components of the cycle	**107.0**	–	–
2. CYCLE OF PROFESSIONAL TRAINING				
ES 20	Operation and repair of electrical equipment	5	1	Examination
ES 21	Fundamentals of reliability theory and diagnostics	3	1	Examination
ES 22	Fundamentals of electrical safety	3	1	Examination
ES 23	Theory of automatic control	5	1	Examination
ES 24	Course work on the discipline "Theory of automatic control"	–	–	Protection
ES 25	Theory of electric drive	6	2	Examination
ES 26	Course project on the discipline "Theory of electric drive"	–	–	Protection
ES 27	Fundamentals of industrial electronics	6	2	Examination
ES 28	Course project on the discipline "Fundamentals of industrial electronics"	–	–	Protection
ES 29	Design and dynamics of electric rolling stock	6	2	Examination
ES 30	Course project on the discipline "Design and dynamics of electric rolling stock"	–	–	Protection
ES 31	Electric vehicle control systems	4	1	Examination
ES 32	Theory of traction of urban and industrial electric transport	5	1	Examination
ES 33	Course project on the discipline "Theory of traction of urban and industrial electric transport"	–	–	Protection

ES 34	Technology of production of electrical equipment of electric traction systems	3	1	Examination
ES 35	Electrical materials science and high voltage engineering	6	2	Examination
ES 36	Methodology of engineering and scientific work	3	1	Test
ES 37	Lean-technologies on electric transport	3	1	Test
	The amount of normative educational components	**58**	–	–
ES 38	Practice	18	–	Test
Disciplines of free choice of the student of a cycle of professional training				
FC 05	Discipline 5**	6	1	*
FC 06	Discipline 6**	6	1	*
FC 07	Discipline 7**	6	1	*
FC 08	Discipline 8**	6	1	*
FC 09	Discipline 9**	6	1	*
FC 10	Discipline 10**	6	1	*
FC 11	Discipline 11**	6	1	*
FC 12	Discipline 12**	6	1	*
	The amount of selective educational components	**48.0**	–	–
	The total amount of educational components of the cycle	**124.0**	–	–
ES 39	Preparation of qualifying work	7.5	–	–
ES 40	Protection of qualification work	1.5	–	Protection
	The total amount of educational and professional program	**240**	–	–

* – the form of final control is determined by the curriculum;
** – the educational component is determined by the results of students choice in accordance with the established procedure.

The logical sequence of the study of educational components is determined by their order of study (for educational components that are studied for several semesters, the beginning of the study of educational components is determined by the first semester of their study). The educational components of the next turn cannot be studied before or simultaneously with the beginning of the study of the educational components of the previous turn.

The order of study of educational components:

1) educational components of the first turn:

physics;
computer technology and programming;
theoretical mechanics;
practice;
2) educational components of the second turn:
theoretical foundations of electrical engineering;
applied mechanics;
fundamentals of metrology and electrical measurements;
electrical materials science and high voltage engineering;
practice;
3) educational components of the third turn:
theory of automatic control;
electric machines;
fundamentals of industrial electronics;
practice;
4) educational component of the fourth turn:
fundamentals of electrical safety;
electric vehicle control systems;
design and dynamics of electric rolling stock;
theory of electric drive;
fundamentals of reliability theory and diagnostics;
practice;
5) educational component of the fifth turn:
preparation of qualification work and its protection;
6) the order of study of other educational components is determined by the curriculum.

4. Forms of certification of applicants for higher education

Forms of certification of applicants for higher education	Certification of applicants for higher education is carried out in the form of public defense of the qualification project (work)
Requirements for qualification work	The qualification project (work) should provide for the solution of a complex specialized task or practical problem of electric power, electrical engineering and/or electromechanics, characterized by complexity and uncertainty of conditions, using theories and methods of electrical engineering. Qualification work should not contain academic plagiarism, fabrication and falsification. Qualification work should be posted on the website of the higher education institution or its structural unit, or in the repository of the higher education institution.

5. Requirements for the availability of an internal quality assurance system for higher education

The Ukrainian State University of Railway Transport has a system of quality assurance of educational activities and quality of higher education (internal quality assurance system), which provides for the implementation of the following procedures and measures:

1) defining the principles and procedures for ensuring the quality of higher education;

2) monitoring and periodic review of educational programs;

3) annual evaluation of applicants for higher education, research and teaching staff of the institution of higher education and regular publication of the results of such evaluations on the official website of the institution of higher education, on information stands and in any other way;

4) providing advanced training of pedagogical, scientific and scientific-pedagogical workers;

5) ensuring the availability of the necessary resources for the organization of the educational process, including independent work of students, according to the educational program;

6) ensuring the availability of information systems for effective management of the educational process;

7) ensuring publicity of information about the educational program, degree of higher education and qualification;

8) ensuring an effective system for preventing and detecting academic plagiarism in the scientific works of employees and applicants for higher education.

Table 1 – Matrix of conformity of study results and competencies

Program study results	Competencies																				
	Integral	General										Special (professional)									
		01	02	03	04	05	06	07	08	09	10	01	02	03	04	05	06	07	08	09	10	11
SR 01	+		+				+							+					+	+		+
SR 02	+		+				+								+					+		+
SR 03	+		+				+									+			+	+		
SR 04	+		+																+	+		
SR 05	+		+				+						+	+						+		
SR 06	+		+		+	+	+		+			+	+						+	+		+
SR 07	+	+				+	+		+			+	+			+				+		+
SR 08	+	+					+		+			+	+			+						
SR 09	+	+					+					+	+			+				+		
SR 10	+			+	+	+	+											+	+		+	+
SR 11	+			+	+	+	+	+	+	+	+										+	
SR 12	+						+	+	+	+	+						+	+	+			+
SR 13	+																+			+	+	
SR 14	+			+	+	+		+														
SR 15	+			+	+		+	+		+	+											
SR 16	+		+	+	+	+	+	+										+	+	+		+
SR 17	+		+			+	+				+		+	+	+			+	+			
SR 18	+		+	+	+	+		+	+		+										+	
SR 19	+					+	+					+	+				+					

Table 2 – Matrix of conformity of study results and educational components

Program study results	Educational components																																								
	EC 01	EC 02	EC 03	EC 04	EC 05	EC 06	EC 07	EC 08	EC 09	EC 10	EC 11	EC 12	EC 13	EC 14	EC 15	EC 16	EC 17	EC 18	EC 19	EC 20	EC 21	EC 22	EC 23	EC 24	EC 25	EC 26	EC 27	EC 28	EC 29	EC 30	EC 31	EC 32	EC 33	EC 34	EC 35	EC 36	EC 37	EC 38	EC 39	EC 40
SR 01																		+	+	+		+												+	+			+	+	+
SR 02															+		+			+			+	+					+	+		+	+	+	+			+	+	+
SR 03																		+	+	+					+	+			+	+		+	+		+			+	+	+
SR 04											+					+																							+	+	+
SR 05								+							+		+				+	+					+	+										+	+	+
SR 06									+	+											+																	+	+	
SR 07												+	+	+	+			+	+	+		+			+	+	+	+	+	+	+			+	+			+	+	+
SR 08								+										+	+		+		+	+	+	+			+	+	+	+	+	+				+	+	
SR 09				+																					+	+			+	+	+	+	+				+	+	+	+
SR 10	+			+	+																															+	+	+	+	
SR 11	+	+	+		+	+																														+		+	+	+
SR 12																+	+					+							+	+		+	+					+	+	+
SR 13				+												+																					+	+	+	+
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SR 18									+	+							+												+	+	+							+	+	
SR 19				+				+													+						+	+	+	+	+	+	+	+			+	+	+	

PhD, Associate Professor,
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PhD, Associate Professor,
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(signature)

Chairman of the student government
of the Faculty of Mechanical and Energy _____ Anastasia KHARCHENKO
(signature)