

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

APPROVED

Minutes of the meeting of the  
Academic Council of the Ukrainian  
State University of Railway  
transportation

May 29, 2018, No. 5

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of the meeting of the Academic  
Council of the Ukrainian State  
University of Railway  
transportation

" 24 " March 2022 № 2

Put into effect  
from the 2022/2023 academic year

Rector  
\_\_\_\_\_ S.V. Panchenko

**EDUCATIONAL PROGRAM**  
**ENERGY MANAGEMENT**

Level of higher education:	first
Degree of higher education:	bachelor
Field of knowledge:	14 Electrical engineering
Specialization:	144 Heat and power engineering

## 1. Preamble

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

- 1) educational and professional program - a single set of educational components (academic disciplines, individual tasks, practices, control measures, etc.) aimed at achieving the learning outcomes provided for by such a program, which gives the right to obtain a certain educational or educational and professional qualification(s);
- 2) The higher education standard defines the following requirements for the educational program:
  - the amount of ECTS credits required to obtain the relevant higher education degree;
  - requirements for the level of education of persons who can start studying under this program and their learning outcomes;
  - a list of mandatory graduate competencies;
  - the normative content of higher education training, formulated in terms of learning outcomes;
  - forms of certification of higher education students;
  - requirements for the creation of educational programs in a field of knowledge, two fields of knowledge or a group of specialties (in the standards of the junior bachelor's degree), interdisciplinary educational and scientific programs (in the standards of the master's degree and doctorate);
  - requirements of professional standards (if any);
- 3) The educational program should include:
  - a list of educational components and their logical sequence;
  - requirements for the level of education of persons who can start studying under this program;
  - the number of ECTS credits required to complete this program, as well as the expected program learning outcomes (competencies) that a higher education student must master;
- 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 of the educational process, forms of current and final control that ensure the achievement of program learning outcomes by the applicant for the relevant degree of higher education. On the basis of the curriculum, individual curricula for each academic year are developed and approved for each higher education student in accordance with the procedure established by the higher education institution.

The Energy Management educational program in the revised version after revision:

- 1) developed on the basis of the Standard of higher education of the first (bachelor's) level in the specialty 144 Heat and Power Engineering, field of knowledge 14 Electrical Engineering, approved and enacted by the order of the Ministry of Education and Science of Ukraine dated 04.03.20, № 372, the working group of the Department of Heat Engineering, Thermal Engines and

of Energy Management of the Ukrainian State University of Railway Transport as part of the Institute:

- VASILENKO  
Oleg Vadymovych
- Acting Head of the Department of Heat Engineering, Thermal Engines and Energy Management,  
D. in Engineering, Team Leader;
- KAGRAMANIAN  
Artur Oleksandrovych
- Associate Professor of the Department of Heat Engineering, Thermal Engines and Energy Management, Ph;
- HAPPY  
Yevhen Yeageniyovych
- Associate Professor of the Department of Heat Engineering, Thermal Engines and Energy Management, Ph;
- WHITE  
Anna Vladimirovna
- Associate Professor of the Department of Heat Engineering, Thermal Engines and Energy Management, Ph.

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

- SUPPORT  
Andrey Ivanovich
- Head of Energy Management Department of the regional branch "Southern Railway" JSC "Ukrzaliznytsia;
- KALASHNIKOV  
Ivan Vladimirovich
- Acting First Deputy of the Kharkiv Branch of the Design and Research Institute of Railway Transport of JSC "Ukrzaliznytsia;
- SLASTIN  
Andrey Viktorovich
- Director of Heating Systems LLC "OTOS".
- KHARCHENKO  
Anastasiia Serhiivna
- 3rd year student (first (bachelor's) level) of the educational program "Heat and Power Engineering, specialty 144 - Heat and Power Engineering.

2) approved at the meeting:

Department of Heat Engineering, Thermal Engines and Energy Management from "December 27, 2021 (Minutes No. 6);  
scientific and methodological commission of the Mechanical and Energy faculty from  
"January 24, 2022 (Minutes No. 7);  
of the Academic Council of the Faculty of Mechanics and Energy dated February 21, 2022 (Minutes No. 6);

3) approved at the meeting of the academic of the Academic Council of the Ukrainian State University of Railway Transport dated March 24, 2022 (Minutes No. 2).

## 2. Profile of the educational program "Energy Management"

### 2.1. General characteristics

Level of higher education	First (bachelor's) level
Degree of higher education	Bachelor's degree
Field of expertise	14 Electrical engineering
Specialty.	144 Heat and power engineering
Restrictions on forms of education	There are no restrictions
Educational qualification	Bachelor's degree in energy management
Qualification in the diploma	Degree (level) of higher education - Bachelor's degree Specialty - 144 Heat and power engineering Educational and professional program - Energy management
Description of the subject area	<p><i>Objects of study and activity:</i> heat and power equipment of thermal and nuclear power plants; heat engineering equipment of industrial and utility companies; steam and hot water boilers; heat engines; heat and mass transfer devices; heat pumping and refrigeration units; heat carriers and working fluids; processes of energy generation, conversion, transmission, distribution, and use.</p> <p><i>The objectives of the educational program are to</i> train specialists capable of independently designing and calculating modern heat and power systems; determining the optimal parameters of thermal devices of various capacities and purposes; conducting energy audits of energy facilities; implementing an energy management system to reduce the consumption of various types of fuel and improve environmental safety.</p> <p><i>Theoretical content of the subject area:</i> theoretical and practical knowledge of the theory of heat and mass transfer, technical thermodynamics, hydrogas dynamics, combustion, energy conversion, technical mechanics, computer-aided design technologies in thermal power engineering.</p> <p><i>Methods, techniques and technologies for</i> energy generation, transmission, efficient and environmentally friendly use, operation, control, monitoring energy equipment, methods of physical and</p>

	<p>mathematical modeling and data processing in the operation of facilities.</p> <p><i>Tools, devices, systems:</i>  main and auxiliary equipment, automation and control equipment;  means technological instrumental, metrological, diagnostic, information and organizational equipment for production processes</p>
Academic and professional rights of graduates	Continuing education at the second (master's) level of higher education. Acquisition of additional qualifications in the system of postgraduate education
Quantity. semesters/years of study	8/3 years 10 months

**2.2. Requirements to the level of education of persons who can start studying under the educational program:** complete secondary education.

**2.3. The number of ECTS credits required to obtain the first (bachelor's) degree of higher education**

- on the basis of complete general secondary education is 240 ECTS credits;
- on the basis of a junior bachelor's degree (educational qualification level "junior specialist"), a higher education institution has the right to recognize and re-recognize no more than 120 ECTS credits obtained within the previous educational program of training of a junior bachelor (junior specialist);
- the internship must be at least 4 ECTS credits.

At least 50 percent of the volume of the educational program should be directed to the acquisition of general and special (professional) competencies in the educational and professional program, defined by the Standard of Higher Education of Bachelor's Degree in Heat and Power Engineering, specialty 144 Heat and Power Engineering, field of knowledge 14 Electrical Engineering, approved and enacted by the order of the Ministry of Education and Science of Ukraine dated 04.03.20 p. № 372.

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

**2.4. Expected programmatic learning outcomes (competencies) that a higher education student must master**

1	<b>Integral competence</b>	Ability to solve complex general, specialized tasks and practical problems in the field of energy management or in the process of studying, which involves the application of theories and methods of electrical engineering and is characterized by complexity and uncertainty of conditions	
2	<b>General competencies</b>	ZK1	The ability to realize one's rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and the need to its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine
		ZK2	The ability to preserve and enhance moral, cultural, scientific values and achievements of society based on an understanding of 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, technology and technology, to use various types and forms of physical activity for active recreation and maintaining a healthy lifestyle
		ZK3	Ability to learn and master modern knowledge
		ZK4	Ability to apply knowledge in practical situations
		ZK5	Skills of using information and communication technologies.
		ZK6	Ability to search, process and analyze information from various sources.
		ZK7	Ability to work in a team.
		ZK8	Ability to communicate in the state language both orally and in writing.
		ZK9	Ability to make informed decisions.
		ZK10	Ability to communicate in a foreign language.
3	<b>Special (professional) competencies</b>	FC1	Ability to apply appropriate quantitative mathematical, scientific and technical methods and computer software to solve engineering problems. tasks in the heat and power industry.
		FC2	Ability to to apply i integrate knowledge i understanding of other engineering disciplines.
		FC3	Ability to to design and operate heat and power equipment
		FC4	Ability to identify categorize i evaluate the effectiveness of of systems i components on based on utilization of analytical methods i modeling methods in the heat and power

			industry
		FC5	Ability to identify, research and solve problems in the field of heat and power engineering, as well as identify constraints, including those related to engineering aspects and environmental, sustainability, health and safety issues and risk assessments in the heat and power industry.
		FC6	Ability to take into account knowledge and understanding of the commercial and economic context when making decisions in the heat and power industry
		FC7	Ability to take into account broader interdisciplinary Engineering context in professional activities in the field of heat and power engineering
		FC8	The ability to utilize scientific and technical literature and other sources of information in professional activities in the heat and power industry
		FC9	The ability to develop plans and projects to ensure the achievement of a specific goal, taking into account all aspects of the problem being solved, including production, operation, maintenance and utilization of heat and power equipment
		FC10	The ability to adhere to professional standards and high level activities in the heat and power industry
		FC11	Ability to ensure quality in the heat and power industry
		FC12	Ability to provide protection of intellectual property, Prepare, execute and fulfill contracts in the heat and power industry

### Program learning outcomes

ELO1. Know and understand mathematics, physics, chemistry at the level necessary to achieve the results of the educational program.

ELO2. Know and understand the engineering sciences underlying the specialty "Heat and Power Engineering" of the relevant specialization, at the level necessary to achieve other program outcomes, including a certain awareness of the latest achievements of science and technology in the field of heat and power engineering.

ELO3. Understanding the interdisciplinary context of the specialty "Heat and Power Engineering."

UN4. Analyze and use modern engineering technologies, processes, systems and equipment in the field of heat and power engineering.

ELO5. Select and apply appropriate standard analytical, computational and

experimental methods; correctly interpret the results of such studies.

ELO6. Identify, formulate and solve engineering problems in heat and power engineering; understand the importance of non-technical (society, health and



security, environment, economy and industry) restrictions.

LO7. Develop and design complex thermal energy products, processes and systems that meet specified requirements, which may include awareness of technical and non-technical (society, health and safety, environment, economy and industry) aspects.

PO8. To apply advanced achievements of electrical engineering and related fields in the design of thermal power facilities and processes.

ELO9. Be able to find the necessary information in technical literature, scientific databases and other sources of information, critically evaluate and analyze it.

LO10. Know and understand technical standards and safety regulations in the field of heat and power engineering.

ELO11. Have laboratory/technical skills, plan and perform experimental research in thermal power engineering using modern techniques and equipment, evaluate the accuracy and reliability of results, and draw reasonable conclusions.

ELO12. Understand the key aspects and concepts of heat and power engineering, technologies of energy production, transmission, distribution and use.

LO13. Understand the basic methods of design and research in thermal power engineering, as well as their limitations.

ELO14. Have the skills to solve complex problems and practical problems involving the implementation of engineering projects and research in accordance with the specialization.

PO15. Understand the basic properties and limitations of materials, equipment and tools, engineering technologies and processes.

EO16. Understand the non-technical (society, health and safety, environment, economy and industry) implications of engineering practice.

LO17. Argue and communicate judgments that reflect thermal energy engineering solutions and related social, environmental, and ethical issues to professionals and non-specialists.

PO18. To be able to manage professional activities, participate in project work, and be responsible for decision-making in the field of heat and power engineering.

The correspondence between learning outcomes and competencies is shown in Table 1, and the correspondence between learning outcomes and educational components is shown in Table 2.

### 3. List of educational components and their logical sequence

N o. s/n	Educational component	Number of ECTS credits	Duration of study (in semesters)	Form of final control
<b>1. GENERAL TRAINING CYCLE</b>				
OK 01	History of Ukraine and Ukrainian culture	4	1	examination
OK 02	Ukrainian language	3	1	offset

OK 03	Foreign language	5	2	test, exam
OK 04	Life safety and basics of labor protection	3	1	offset
OK 05	Ecology	3	1	offset
OK 06	Theoretical mechanics	3	1	examination
OK 07	Water treatment	3	1	offset
OK 08	Physical education		4	offset (4)
OK 09	Higher mathematics	15	3	credit (2), exam
OK 10	Physics.	8	2	test, exam
OK 11	Descriptive geometry and engineering graphics	8	2	test, exam
OK 12	Chemistry	3	1	examination
OK 13	Technical mechanics	6	2	test, exam
OK 14	OT and programming	7	2	test, exam
	Scope of normative educational components	<b>71</b>	-	-
<b>Disciplines of free choice of the student of the general training cycle</b>				
VK 01	Discipline 1**.	3	1	*
VK 02	Discipline 2**.	3	1	*
VK 03	Discipline 3**.	3	1	*
VK 04	Discipline 4**.	3	1	*
	Scope of elective educational components	<b>12</b>	-	-
	Total volume of educational components of the cycle	<b>81,5</b>	-	-
<b>2. PROFESSIONAL TRAINING CYCLE</b>				
OK 15	Fluid dynamics	7	2	test, exam
OK 16	Technical thermodynamics	10	2	test, exam
OK 17	Heat and mass transfer	10	2	test, exam
OK 18	Economics, organization and planning of production	6	2	offset (2)
OK 19	Materials Science and Technology	3	1	offset
OK 20	Thermal processes and installations	6	1	examination
OK 21	Boiler installations, fuel and combustion theory	6	1	examination
OK 22	Sources of heat supply	5	1	examination
OK 23	Energy audit	3	1	examination
OK 24	Thermal power plants	4	1	offset

OK 25	Automation of heat and power plants	6	1	examination
OK 26	Refrigeration units and heat transformers	5	1	offset
OK 27	Heating, ventilation and air conditioning	5	1	examination
OK 28	Rules of technical operations, rolling stock and train traction	3	1	offset
OK 29	Basics of design automation	3	1	offset
	Scope of normative educational components	<b>82</b>	-	-
<b>Disciplines of free choice of the student of the professional training cycle</b>				
VK 05	Discipline 1**.	6	1	*
VK 06	Discipline 2**.	6	1	*
VK 07	Discipline 3**.	6	1	*
VK 08	Discipline 4**.	6	1	*
VK 09	Discipline 5**.	6	1	*
VK 10	Discipline 6**.	6	1	*
VK 11	Discipline 7**.	6	1	*
VK 12	Discipline 8**.	6	1	*
VK 13	Discipline 9**.	6	1	*
VK 14	Discipline 10**.	6	1	*
	Scope of elective educational components	<b>60</b>	-	-
	Total volume of educational components of the cycle	<b>142</b>	-	-
<b>3. PRACTICAL TRAINING</b>				
OK 29	Industrial practice	4,5	-	offset
OK 30	Technological practice	4,5	-	offset
OK 31	Operational practice	6,0	-	offset
	In general, in terms of the practical component	<b>15,0</b>	-	-
<b>4. STATE CERTIFICATION</b>				
OK 32	Certification exam	1,5	-	examination
	<b>Total volume of the educational program</b>	<b>240</b>	-	-

\* - the form of final control is determined by the curriculum;

\*\* - educational component is determined by results of selection students in accordance with the established procedure.

The logical sequence of studying the educational components is determined by their order of priority (for educational components that are studied over 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 stage cannot be studied before (or simultaneously with the start of) the study of the educational components of the previous stage.

The order of studying educational components:

1) educational components of the first stage:

History of Ukraine and Ukrainian culture; Ukrainian language;  
foreign language;  
chemistry;  
Physics;  
higher mathematics;  
computer science and programming; water treatment;  
life safety and basics of labor protection; materials science and materials technology.

2) educational components of the second stage:

theoretical mechanics;  
technical mechanics; fluid dynamics;  
technical thermodynamics;  
heat and mass transfer;  
basics of energy audit; industrial practice.

3) educational components of the third stage:

heat engineering processes and installations; boiler plants;  
thermal power plants;  
technological practice.

4) educational component of the fourth stage:

economic evaluation of energy saving projects and production planning; energy production and distribution systems;  
automation of heat and power plants; refrigeration units and heat transformers; operational practice.

5) educational component of the fifth stage:

comprehensive state exam.

6) sequence study other educational component of the educational program is determined by the curriculum.

#### **4. Forms of certification of higher education applicants**

Forms of certification of higher education applicants	Certification is carried out in the form of a single state qualification exam (qualification exam)
Requirements for the Unified State Qualification Exam	The Unified State Qualification Exam (qualification exam) should test the achievement of learning outcomes

#### **5. Requirements for an internal quality assurance system for higher education**

The Ukrainian State University of Railway Transport has a system for ensuring the quality of educational activities and the quality of higher education (internal quality assurance system), which provides for 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 higher education students, research and teaching staff of the higher education institution and regular publication of the results of such evaluations on the official website of the higher education institution, on information stands and in any other way;
- 4) Providing professional development for pedagogical, scientific and research staff;
- 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 qualifications;
- 8) ensuring an effective system for preventing and detecting academic plagiarism in the scientific works of employees and students.

Table 1 - Matrix of correspondence between learning outcomes and competencies

Program learning outcomes	Competencies																					
	Integral competence	General competencies								Special (professional) competencies												
		ZK01	ZK02	ZK03	ZK04	ZK05	ZK06	ZK07	ZK08	FC01	FC02	FC03	FC04	FC05	FC06	FC07	FC08	FC09	FC010	FC011	FC012	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
RN 01	Ability to solve complex general, specialized and tasks and practical problems in the energy sector in the field of energy management or in the process of education, which involves the application of theories and methods of electrical engineering and is characterized by complexity and the uncertainty of the environment		+							+		+				+		+				
PH 02		+	+					+				+	+		+		+		+		+	+
PH 03		+			+		+		+													
RN 04			+	+	+							+	+	+	+			+	+			+
PH 05			+	+	+							+	+	+	+			+				
PH 06		+	+	+	+				+				+	+	+	+			+		+	
RN 07		+	+	+	+	+			+		+	+	+	+	+	+	+	+	+	+	+	+
PH 08			+	+	+							+	+	+	+	+	+	+			+	+
RN 09		+		+	+		+		+	+		+		+			+	+	+			+
PH 10			+			+	+	+			+		+		+		+			+		
RN 11			+	+	+						+		+	+			+		+			
PH 12			+	+	+		+	+			+	+	+	+	+	+	+	+			+	
RN 13			+	+	+		+	+			+	+	+	+	+	+	+	+	+	+	+	+
RN 14			+	+	+		+	+	+	+	+	+	+	+	+	+			+	+	+	
PH 15			+		+		+						+			+		+	+	+	+	+
RN 16			+		+	+				+			+		+		+					
RN 17		+		+	+		+						+		+		+					
RN 18			+	+	+	+	+	+			+		+		+				+	+	+	

Table 2 - Matrix of correspondence between learning outcomes and educational components

Program learning outcomes	Educational components																																		
	OK01	OK02	OK03	OK04	OK05	OK06	OK07	OK08	OK09	OK10	OK11	OK12	OK13	OK14	OK15	OK16	OK17	OK18	OK19	OK20	OK21	OK22	OK23	OK24	OK25	OK26	OK27	OK28	OK29	OK30	OK31	OK32	OK33		
RN 01									+	+	+	+																					+	+	
PH 02				+		+					+		+						+												+	+	+	+	
PH 03	+	+	+	+	+													+															+	+	
RN 04							+								+	+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+
PH 05															+	+	+			+	+	+	+			+	+	+	+	+	+	+	+	+	+
PH 06				+	+															+	+	+	+			+	+	+	+	+			+	+	
RN 07				+	+													+		+	+	+	+			+	+	+	+	+	+	+	+	+	+
PH 08															+											+			+		+	+	+	+	
RN 09	+	+	+	+	+	+							+					+	+					+						+	+	+	+	+	+
PH 10				+	+													+			+	+		+	+					+	+	+	+	+	
RN 11							+								+	+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+
PH 12															+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
RN 13							+												+	+			+							+	+	+	+	+	
RN 14																			+			+	+							+	+	+	+	+	
PH 15													+		+	+	+		+	+	+								+	+	+	+	+	+	+
RN 16				+	+		+																					+	+	+	+	+	+	+	+
RN 17				+	+														+														+	+	
RN 18																			+										+		+	+	+	+	

Acting Head of the Department of Heat Engineering, Thermal  
of engines and energy management O .V. Vasilenko

Associate Professor of the Department of Heat Engineering, Thermal  
engines and energy management A. O. Kagramanyan

Associate Professor of the Department of Heat Engineering, Thermal  
of engines and energy management E. E. Schastny

Associate Professor of the Department of Heat Engineering, Thermal  
of engines and energy management G .V. Bilovol

Chairman of the student self-government body  
of the Faculty of Mechanical and Energy  
Engineering,  
3rd year student (first  
(bachelor's) degree) A.S. Kharchenko