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 Transport № 2 from "23" February 2016
(In the edition after revision. Minutes of the meeting of the Academic Council Ukrainian State University of Railway Transport № 2 from "March 18, 2021)
Put into action from the 2021/2022 academic year.

Rector of the Ukrainian State University of Railway Transport

Sergey PANCHENKO

EDUCATIONAL PROGRAM
SPECIALIZED COMPUTER SYSTEMS

Level of higher education: first
Degree of higher education: bachelor
Field of knowledge: 12 Information technologies
Specialty: 123 Computer Engineering

Kharkiv - 2021

1. Preamble

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

1) educational and professional program - the only set of educational components (training courses, individual tasks, practices, control measures , etc.) aimed at achieving the envisaged this program outcomes study, which gives the right to obtain certain educational or educational and vocational (professional) skills (qualifications) ;

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

the amount of credits ECTS required for obtaining the relevant degree of higher education;

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

list of mandatory competencies of the graduate;

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

forms of certification of applicants for higher education;

requirements to create educational programs of training for industry knowledge, the two branches of knowledge or a group of professions (in the standards of junior Bachelor) interdisciplinary educational and research programs (master standards and Doctor of Philosophy);

requirements of professional standards (if they exist);

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 credits ECTS necessary for the implementation of this program, as well as the expected program results study (competence), which should be acquire competitor of higher education;

4) institution of higher education on the basis of appropriate education program is developing a training plan, which determines the list and amount of educational components of credits ECTS their logical sequence, forms of organization of educational process, types and amount of training sessions, schedule of educational process, forms current and final control, which provides achievement by the applicant of the corresponding degree of higher education of program results of training. On the basis of the training plan in the prescribed higher education agenda for each applicant higher education developed and approved individual learning plans for each academic year.

Educational program "Specialized computer systems" developed on the basis of the standard of higher education of the first (bachelor's) level in the specialty 123

"Computer Engineering", approved and put into effect by the order of the Ministry of Education and Science of Ukraine from 19.06.2018 №1262, the law of Ukraine "On Amendments to Certain Laws of Ukraine on Improving Educational Activities in Higher Education" and guidelines for developing standards of higher education approved by the order of the Ministry of Education and Science of Ukraine 00600 from 01.06.2016.

The educational program in the version after seeing developed by a working

group of the department specialized computer systems with regard analysis of the results of study and analysis of content related educational programs of other institutions of education Ukraine and European countries that own the acquired experience, offers stakeholders, representatives of the student government and individual students according to the results of poll.

Composition of the working group

1. Pavlenko Yevhen Petrovych - Candidate of Technical Sciences, Associate Professor of the Department of Specialized Computer Systems - Chairman of the Working Group
2. Miroshnyk Maryna Anatoliivna - Doctor of Technical Sciences, Professor of the Department of Specialized Computer Systems;
3. Dotsenko Sergii Ilyich - doctor technical Science, Associate Professor of Specialized Computer Systems;
4. Moiseenko Valentin Ivanovich - doctor of technical sciences, Professor of the Department of Specialized Computer Systems;
5. Fedorin Dmytro. - student 4 course specialty 123 "Computer Engineering".

With the involvement and consideration of the proposals and needs of such stakeholders:

1. Production Division "Kharkiv Branch" of the branch "Main Information and Computing Center" of PJSC UZ - Chief Engineer Davydov Ilya Valeriyovych;

2. Computer Technology Center "TAIS" - Director Yuri Mikhailovich Bezdelny ;
3. Ltd. "PROFTSOFT" - Director Alexander V. Petrychenko;
4. SPE LLC "Transport Technologies" - Head of Department Semchuk Roman.

Volodymyrovych.;
5. Head student municipality Ukrainian State University of Railway Transport - Ostroverkh H .

The educational program received reviews and feedback from employers:

1. Ltd. "PROFTSOFT" - Director Petrychenko A. B .;
2. LLC "RADIO INFORMATION TECHNOLOGIES" - Director Kamensky SO

IN process making changes taken into account results annual survey of employers and students.

The educational program was considered and approved at the meeting of the Department of Specialized Computer Systems on January 27 , 2021 , Minutes № 8.

Methodical examination carried out scientific-methodical commission of the faculty of information-control systems and technologies from January 27 , 2021 , protocol № 5.

Approved at the meeting of the Academic Council of the Faculty of Information Control Systems and Technologies on January 27, 2021 , Minutes № 6.

Approved at the meeting of the Academic Council of the Ukrainian State University of Railway Transport on March 18, 2021, Minutes № 2.

2. PROFILE OF THE EDUCATIONAL PROGRAM SPECIALIZED COMPUTER SYSTEMS

2.1 General characteristics

Level of higher education	The first (bachelor's) level
Degree of higher education	Bachelor
Name of the field of knowledge	12 "Information Technology"
Name of specialty	123 "Computer Engineering"
Restrictions on forms of education	no
Educational qualification	Bachelor of Computer Engineering

Professional qualification	Specialist of Information Technology
Qualification in diploma	Educational qualification - Bachelor of Computer Engineering: Professional qualification - specialist in information technology

Description of the subject area	**Object (s) of study and (or) activities** : algorithms and data structures , hardware and software components computer systems. networks and components; system software software (operating systems, utilities, tools for creating and researching programs); processing methods ; transmission, conversion and storage of information; circuitry modern computer systems and their components. **Learning objectives :** design, creation and maintenance computer systems, networks and their components; maintenance of computer systems and networks; creation of system and application programs within the functional, procedural and object-oriented approach for desktop, mobile, portable, built-in and cloud systems; design of circuit devices. **Theoretical content of the subject area:** principles of work and architecture microprocessor technology, peripherals devices, components of computer systems in railway transport and other industries **Methods, techniques and technologies:** methodologies for designing computer systems, networks and their components; methods of object-oriented, procedural and functional programming; methods and means of computer engineering; software development technologies and hardware of parallel and distributed data processing systems. **Tools and equipment:** circuit stands; information and measuring equipment; program libraries ; system software (operating systems and utilities); means of creation and research programs

Academic and professional rights of graduates	Possibility to study according to the program of the second (master's) level. The training program preparing bachelors specialty "Computer Engineering" is based on international standards and contains unified list of recommended basic disciplines. This ensures the acquisition of extensive knowledge and skills in the field of modern computing and information technology, and allows graduates to undergo advanced training in recommended enterprises. manufacturers.
Employment of graduates	**Main positions** - Technical specialists in the field of computer technology. Technicians-programmers. A technician with a configured computer system. Technician of structured cabling system. Computer (information and computing) center technician. Specialist infocommunications. Specialist of development computer programs. Technician of the system administration. Technician-programmer. Specialist Information Technology

2.2. Requirements for the level of education of persons who can start training in the educational-professional program: the presence of a complete general secondary education with a term of study of 11 years, or a bachelor's degree.

2.3 Number of credits ECTS necessary for the implementation of educational and professional programs .

On the basis of complete general secondary education with a term of study of 11 years is 240 ECTS credits. On the basis of complete general secondary education with a term of study of 12 years is 180-240 ECTS credits. At least 50% of the educational program should be aimed at providing general and special (professional) competencies in the specialty, defined by the standard of higher education.

To obtain a bachelor's degree on the basis of a junior bachelor's degree, a university has the right to reduce the volume of the educational program. The program may specify restrictions on the possibility of obtaining a bachelor's degree based on the degree of junior specialist and the scope of such an educational program.

The total volume of sample subjects is not less than 25% ofthe total volume of credits ECTS. There must be at least 35 percent of the educational program

aimed at obtaining general and special (professional) competencies in the educational-professional program, defined by the Standard of Higher Education. The volume of disciplines of free choice students must be not less as 25 per cent of the total number of credits ECTS specified educational program.

2.4. Expected program results study (competence), which should be acquire competitor Higher Education

Integral competence	Ability to solve complex specialized problems and practical problems in the field of information technology or in the learning process , which involves the use of certain theories and methods of relevant science and characterized by complexity and uncertainty of conditions	
General competence	***System competencies***	
	ZK1.	Ability to apply knowledge in practice situations
	ZK2.	Ability to adapt and act in a new situation
	ZK3.	Ability to work in a stand-alone, as in team
	ZK4.	Ability to evaluate and ensure quality work performed
	Instrumental competencies	
	ZK5.	Ability to analyze and synthesize
	ZK6.	The ability to communicate official language as orally so written
	ZK7.	Ability to communicate in a foreign language

	ZK8.	Ability to use informational and communication technologies in production processes and processes of organization of activity
	ZK9.	Ability to search, process and analyze information from various sources on existing and emerging technologies in the field of information technology and intelligent information technologies (systems)
	3K10.	Ability to formulate tasks and solve problems in the field of railway transport on based on knowledge of innovative ways of industry development in the concept of Industry 4.0.
	3K11.	Skills to use basic knowledge of the basics in professional and social activities philosophies, psychology, foreign languages that promote the development of general culture and socialization personality, inclination to ethical values, knowledge of national history, economics and law, understanding of the causal links of development

		society
	Interpersonal competencies	
	ЗК12	The ability to process activities for the profession to be critical and self-critical
	ЗК13	Be able to work in international projects cooperation in the specialty
	ЗК14.	Ability to work in professional and social activities based on ethical considerations (motives)
	ЗК15.	Ability in professional and social activities to act in compliance with environmental safety standards and energy recovery
Professional competence	***General professional competencies***	
	ЗПК1	Skills use in professional activities basic knowledge of mathematics, the use of mathematical apparatus in solving applied and scientific problems in the field of computer engineering
	ЗПК2	Skills use in professional activities basic knowledge of physics, theory of electric and magnetic circuits
	ЗПК3	Skills use basic knowledge in professional and social activities patterns of random phenomena and skills apply probabilistic and statistical methods to solve professional problems
	ЗПК4	Skills apply in professional activities methods of construction and analysis of effective algorithms, based on knowledge of the basics of the theory of numerical methods
	ЗПК5	Skills to apply in professional activity knowledge of discrete structures and modern methods discrete mathematics for analysis and synthesis of complex systems
	ЗПК6	Skills to apply in professional activity knowledge of theoretical and applied bases computer electronics and circuitry

	Special-professional competencies	
	SPK1	Ability to apply in professional activities modern programming languages of data structures
	SPK2	Ability to apply knowledge of theoretical (logical and arithmetic) basics of construction modern computers and their architecture. in the process

		construction and operation of specialized critical systems computer systems .
	SPK3	Ability to carry out technical development computer engineering solutions based on knowledge of circuitry
	СПК4	Ability to apply methods and tools for developing elements of system software based on knowledge of system features programming
	СПК5	Ability to develop and organize the operation of operating rooms systems based on knowledge of the peculiarities of building system software, as well as the general principles of organization and operation of operating systems
	СПК6	Ability to use modern computer tools system, functional, design and technological design of computer systems and networks, using the acquired knowledge of methods automated design.
	СПК7	Ability to apply knowledge in practice general methodological principles of construction of specialized computer systems for critical use with transport organization to ensure high-performance information processing .
	СПК8	Ability to apply knowledge of principles methods and means of design, construction and maintenance of modern computer networks of various types and purposes, including for the needs of railway transport.
	СПК9	Ability to carry out software development for computer systems with parallel or distributed architecture, have the means of modern languages and libraries of parallel programming
	СПК10	Ability to apply in professional activities modern theories of database organization , methods and technologies of their development and use.

	СПК11	Ability to apply in the process of professional activity methods and means of information protection in computer systems and networks with modern cryptosystems, in accordance with legislation and standards in this area.

	СПК12	Ability to apply modern technologies and tools for developing complex software systems (software engineering) at all stages of the life cycle development
	СПК13	Ability to apply in professional activities the acquired knowledge on the basics of life safety and labor protection

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

3. List of educational components and their logical sequence

The program results of the first (bachelor's) educational level of the bachelor's degree in the specialty 123 "Computer Engineering", which determine the normative content of training are:

Knowledge	N1. Know and understand the scientific principles that underlie the functioning of computer tools, systems and networks. N2. Mother skills experiments, collecting data and modeling to computer systems, conducting experiments and analyzing their results. N3. Know the latest technologies in computer engineering. N4. Know and understand the impact of technical solutions in social, economic, social and environmental contexts. N5. Have knowledge of the basics of economics and project management.

Skills	N6. Be able to apply knowledge to identify, formulate and solve technical problems specialties, using the methods that are most suitable for achieving the goals. N7. Be able to solve problems of analysis and synthesis of tools specific to the specialty. N8. Be able to think systematically and apply creative abilities to generate new ideas. N9. Be able to apply knowledge of technical characteristics, design features, purpose and rules of operation of software and hardware of computer systems and networks to solve technical problems of the specialty. N10. Be able to develop software for embedded and distributed applications, mobile and

	hybrid systems expect to operate typical for specialty equipment. N11. Be able to search for information in various sources to solve problems of computer engineering. N12. Be able to work effectively as an individual, so also in the team. N13. Be able to identify, classify and describe the operation of specialized computer systems and their components. N14. Be able to combine theory and practice, as well as make decisions and develop strategies for solving problems of the specialty, taking into account universal values, social, state and industrial interests. N15. Be able to perform experimental research on professional topics. N16. Be able to evaluate the results obtained and defend the decisions made with arguments .
Communication	N17. Communicate orally and in writing with professionals questions in Ukrainian and one of the foreign languages (English, German, Italian, French, Spanish). N18. Use information technology for effective communication in professional and social levels.

3 List of educational components and their logical sequence

Code n / a	Components of the educational program (disciplines, practices, qualification work)	Number loans	Form final control *
	2	3	4
1. The cycle of general training			
Mandatory components of the OP			
1	Higher mathematics and probability theory	17	exam
2	History and culture of Ukraine	3	test
3	Ukrainian language by professional direction	3	test

4	Physics	10	exam
5	Engineering and computer graphics	3	test
6	Algorithms and methods of calculations	3	test
7	Economic theory and economics of railway transport	6	test
8	Philosophy	3	test
9	Foreign language for professional purposes	5	test
10	TAU digital systems	7	exam
	Required components together	**60**	

	Selective components OP		
	Custom training discipline 1 **	3	test
	Custom training discipline 2 **	3	test
	Custom training discipline 3 **	3	test
	Custom training discipline 4 **	3	test
	Selective components together	**12**	

	2	3	4
2. Cycle of professional training			
Mandatory components of the OP			
1	Software Engineering	7	exam
2	Operating systems	8	test
3	Computer electronics and circuitry	8	exam
4	Programming	8	test
5	Languages describing hardware tools	8	test
6	Technologies and automation designing Digital prystroyv and COP	8	exam test
7	Parallel and distributed systems and Cloud-technology	9	copy amen
8	Information systems and informational technologies in railway transport	6	hall ik
9	Technical diagnosis and test suitability of digital devices, computer systems, networks and software maintenance	9	copy amen
10	Coding theory and information security	8	exam
11	Organization and management systems of the database	8	exam
12	Computer systems and networks	8	exam
13	Technological processes on railway transport	8	test
14	Foundations protection labor and security life activities	3	test
	Practice	8	test
	Required components together	**114**	
	Diploma design	5	
	State certification	1	test
Selective components of the OP			
	Custom training discipline 1 **	6	test
	Custom training discipline 2 **	6	test
	Custom training discipline 3 **	6	test
	Custom training discipline 4 **	6	test
	Custom training discipline 5 **	6	test
	Custom training discipline 6 **	6	test
	Custom training discipline 7 **	6	test
	Custom training discipline 8 **	6	test
	Selective components together	**48**	
Total volume of the general training cycle :		**72**	
The total volume of the cycle of professional training :		**168**	
Total amount of required components :		**180**	

Total amount of sample components :	**60**
in fact including the choice of students :	**60**
TOTAL VOLUME OF THE EDUCATIONAL PROGRAM	**240**

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

The logical sequence of studying educational component is determined by their sequence for the start of the study (for the educational component, are studied for several semesters start studying educational component is determined by the first semester of study). The educational components of the next turn cannot be studied before or at the same time as 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:

- disciplines of the general training cycle ;

2) educational components of the second stage:

- discipline cycle of professional training;

3) educational components of the third stage:

- practical training;

4) educational component of the fourth stage:

preparation for the defense of the final qualifying work.

5) 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 is carried out in the form of a single state qualifying exam (qualifying examination) and public defense of qualifying work
Requirements for a single state qualifying exam	The Unified State Qualification Exam (Qualification Exam) should test achievement learning outcomes

Requirements for qualification work	Qualification work involves solving a complex specialized task or practical problems, and must demonstrate the ability to graduate to develop tools and automation, methodological, algorithmic and software control systems, perform research and find information with a given theme with the use of theories and methods specialty. Qualification work should not contain academic plagiarism, fabrication, falsification. Qualifying work must be published on the official website or in the repository

	Ukrainian State University of Railway Transport, or the website of its structural unit

5. Requirements to the presence of the system of internal provision of quality 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 implementation of the following procedures and measures:

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

2) implementation monitoring and periodic revision of educational programs;

3) annual evaluation of higher education seekers, 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 advanced training of pedagogical, scientific and scientific-pedagogical workers;

5) providing the necessary resources to the educational process, in fact including independent work of students on an 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 correspondence of learning outcomes and competencies

Competences	Knowle dge	Skills	Communication	Autonomy and responsibility
Integral competence				
	Conceptual knowledge acquired in the process of learning and professional activity, including certain knowledge of modern achievements. Critical understanding of basic theories and principles. methods and concepts in teaching and professional activities	Solving complex unpredictable tasks and problems in specialized areas of professional activity and. or training that involves the collection and interpretation of information (data), the choice of methods and tools . Using, adaptation and improvement of computer technologies, application of innovative approaches to their creation	Reporting information and ideas to specialists and non-specialists . problems, solutions and personal experience in the field of professional activity, the ability to effectively form a communication strategy	Management of complex actions or projects, responsibility for decision-making in unpredictable conditions, responsibility for professional development of individuals and groups of people, ability to further study with a high level of autonomy
General competencies				
Z1	N1, N3	N7. N16	N17, N18	N19
Z2	N1. N4. N5	N8, N9. N11, N12, N14	N17. N18	N19. N20
Z3	N4	N9-N15	N17. N18	N19. N21
Z4	-	-	N17	N20
Z5	-	-	N17. N18	N19. N20. N21
Z6	N4	N11	N18	N20
Z7	N2. N5	N7. N8, N16	N17. N18	N19. N20. N21
Z8	N5	N7. №-N12. N16	N17. N18	N20. N21
Z9		N12. N16	N17. N18	N19. N20. N21
Z10	N1.N2.N3	N6-N8. N11. NI3. N15. N16	N17. N18	N19. N20
Special (professional) competencies				
P1	N2. N4. N5	N7. N9. N10	-	N20
P2	N1. N2. N4. N5	N6-N8, N13. N16	N17. N18	N20
P3	N1. N2	N6. N8. N9. N13	N18	N20
P4	N1. N2, N5	N6. >"8-M3. N16	N18	N20
P5	M.X2.X5	N6. N$-N13. N16	N18	N20
P6	N2. N4	N8. N9. N11. N12. N16	N17, N18	N19. N20. N21
P7	N4	N9. N11. N12. N16	N17. N18	N19. N20. N21
P8	N2. N4	N9. N11. N12. N16	N17	N19. N20. N21
P9	N2. N6	N9. N11. N12. N16	N17	N19. N20. N21
P10	N2. N4	N9-N12	-	N19. N20. N21
P11	N5	N8. N11. N12. N16	N17. N18	N21
P12	N1. N2	N6-N13. N16	-	N20
PI3	N1. N2. N4. N5	N6-N13. N16	N17. N18	N20
P14	N1. N2, N5	N6-N13. N16	N18	N20
P15	MJI3. N4	N6-N8.N14.N14-N16	N17. N18	N19. N20

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

	Competences																										
Program results	Integral competence	Загальні компетентності										General competencies															
		Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	PI3	P14	P15	
N1		+	+								+		+	+	+	+							+	+	+	+	
N2								+			+	+	+	+	+	+	+		+	+	+		+	+	+	+	
N3		+		+							+															+	
N4			+				+					+	+				+	+	+	+	+			+		+	
N5			+					+	+			+	+		+	+						+		+	+		
N6											+		+	+	+	+							+	+	+	+	
N7		+						+	+		+	+	+										+	+		+	
N8			+					+			+		+	+	+	+	+					+	+	+	+	+	
N9			+	+					+			+		+	+	+	+		+	+	+				+		
N10				+					+			+			+	+		+			+				+		
N11			+	+			+		+		+				+	+	+	+	+	+	+	+			+	+	
N12			+	+					+	+					+	+	+	+	+	+	+	+			+		
N13				+							+		+	+	+	+							+	+	+		
N14			+	+																						+	
N15				+							+															+	
N16		+						+	+	+	+		+		+	+	+	+	+	+		+	+	+	+	+	
N17		+	+	+	+	+		+	+		+		+				+	+	+	+		+		+		+	
N18		+	+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+		+		+	+	+	
N19		+	+	+				+		+	+						+	+	+	+	+					+	
N20			+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
N21				+				+	+	+							+	+	+	+	+	+					