MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

EDUCATIONAL AND PROFESSIONAL PROGRAM "NETWORK TECHNOLOGIES AND TELECOMMUNICATIONS"

Second (master's) level of higher education

Specialty “172 Electronic communications and radio engineering”

Fields of science Electronics, automation and electronic communications

Qualification: Master's degree in electronic communications and radio engineering

APPROVED
BY THE ACADEMIC COUNCIL
OF NTU "KhPI"

Head of the academic council

_____L.L. Tovazhnyanskyi

Protocol No._____of

"_ _" 2023

Rector of NTU"KhPI"_____ / E.I. Sokol /

(order No. ____ from"___"_____2023

Kharkiv 2023

LETTER OF AGREEMENT
educational and professional program

Level of higher education	Second (master's)
Discipline	17 Electronics, automation and electronic communications
Specialty	172 Electronic communications and radio engineering
Qualification	Master's degree in electronic communications and radio engineering

APPROVED
Scientific and methodical commission
from the specialty
"Electronic communications and radio engineering»
Chairman of the commission

_____ Pavlo PUSTOVOYTOV

"____"_____2023

RECOMMENDED
Methodical Council of NTU "KhPI"
Deputy Chairman of the Methodical Council

_____Ruslan Mygushchenko

"____"_____2023

AGREED
Head of the department
information systems named after V.O. Tailor

_____ Pavlo PUSTOVOYTOV

"____"_____2023

AGREED
Director of the educational and scientific institute
computer modeling, applied physics and mathematics

_____Aleksii LARYN

"____"_____2023

APPROVED AND BROUGHT INTO FORCE

By order of the rector of the National Technical University "Kharkiv Polytechnic Institute" from "_____" _____2023 No. _____.

PREFACE

Developed by project group of the “information systems” department of Institute IKM of National Technical University "Kharkiv Polytechnic Institute»:

1. Professor Pavlo Pustovoitov - head of the department “information systems named after V.O. Kravets”, head of the project group;
2. Professor Oleksandr Serkov - professor of the department “information systems named after V.O. Kravets” (guarantor of the educational program);
3. Professor V.S., Breslavets - professor of the department “information systems named after V.O. Kravets”;
4. Associate Professor G.V. Sokol - associate professor of the department “information systems named after V.O. Kravets”;
5. Associate professor L.O. Nikitina - associate professor of the department “information systems named after V.O. Kravets”.

Reviewers:

1.Doctor of Technical Sciences, Professor Trubchaninova Karina Arturivna, Professor of the Department of Transport Communications of the Ukrainian State University of Railway Transport;

2.Doctor of Technical Sciences, Professor Lemeshko Oleksandr Vitaliyovych, Head of the Information and Communication Engineering Department of the Kharkiv National University of Radio Electronics.

Reviews of external stakeholders:

1. “New Line Technology” company

2. Company “KharkivOnline”

3. Research and Design Institute “Molniya”

1. PROFILE OF THE EDUCATIONAL AND PROFESSIONAL SPECIALIZED PROGRAM IN SPECIALTY 172 "ELECTRONIC COMMUNICATIONS AND RADIO ENGINEERING"

1 - General information	
Full name of the institution of higher education and structural division	National Technical University "Kharkiv Polytechnic Institute" Department of Information Systems named after V.O. Kravets
Degree of higher education and the title of the qualification in the original language	Master's degree Educational qualification - Master's degree in electronic communications and radio engineering
The official name of the educational program	Educational and professional program "Network technologies and telecommunication"
Type of diploma and scope of the educational program	Master's degree, single, 90 ECTS credits, 1.4 years
Availability of accreditation	Specialty accreditation certificate UD 21017678, valid until 2029
Program cycle / level	FQ-EHEA – the second cycle, EQF LLL – level 7, NRK – level 7/Master
Prerequisites	Having a bachelor's degree
Language(s) of instruction	Ukrainian / English
The term of validity of the educational program	According to the validity period of the accreditation certificate
Internet address of permanent accommodation description of the educational program	http://web.kpi.kharkov.ua/kmmm/uk/ http://blogs.kpi.kharkov.ua/v2/nv/
2 - The purpose of the educational program	
The purpose of the educational program is to train specialists in electronic communications and radio engineering who are capable of solving complex problems in research, design, modernization, implementation, and operation of modern electronic communication and radio engineering systems, complexes, technologies, devices, and components. **Objects of study and activities:** electronic communication and radio engineering systems, complexes, technologies, devices, and their components. **Specializations** are focused on training specialists with expertise in modern telecommunication technologies, mathematical methods, and information technologies for the creation of telecommunication systems and networks with the required level of service quality.	
3 – Characteristics of the educational program	
Subject area (field of knowledge, specialty, specialization)	Field of science: 17. Electronics, automation and electronic communications Specialty: 172.Electronic communications and radio engineering
Orientation of the educational program	**Educational and Professional** The program has an applied nature and aims to train specialists in the field of professional and technical activities utilizing modern telecommunication technologies for the development of telecommunication systems and networks. It focuses on studying a comprehensive set of technologies, tools, methods, and approaches for processing, storing, and transmitting information over

	distances, as well as the application of electromagnetic oscillations and waves. This includes their use in radar and radio navigation, as well as in the control and management of machines, mechanisms, and technological processes in electronic, medical equipment, measuring devices, and systems. **Theoretical content of the subject area:** Concepts, categories, principles, standards, models, and methods for the design and operation of electronic communication and radio engineering systems, complexes, technologies, devices, and their components. **Methods, techniques, and technologies:** Research, design, modernization, implementation, and operation of modern and advanced electronic communication and radio engineering systems, complexes, technologies, devices, and their components. **Tools and equipment:** The latest software, hardware, and integrated hardware-software tools used in professional activities for research, design, modernization, implementation, and operation of modern electronic communication and radio engineering systems, complexes, technologies, devices, and their components.
The main focus of the educational program	**Research in the Field of 17 "Electronics, Automation, and Electronic Communications"** The program emphasizes the application of innovative methods and technologies in the development and operation of information and telecommunication networks across enterprises, institutions, and organizations. **Key words:** signal processing, information transmission, telecommunication systems, radio engineering systems, QoS (Quality of Service), telecommunication networks, radio engineering networks, software, and hardware.
Features of the program	**The program fosters the formation and development of general and professional competencies in the implementation and application of telecommunication and radio engineering technologies.** These competencies enhance the graduate's social stability and mobility in the labor market, equipping them with the ability to solve specialized tasks and practical problems in the field of electronic communications and radio engineering, characterized by complexity and uncertain conditions. **Internships** are conducted in companies and organizations providing telecommunication services, ensuring practical training in a real-world environment aligned with the graduate's future professional activities.
4 – Eligibility of graduates to employment and further education	
Suitability for employment	**Employment opportunities** include positions at enterprises, companies, and organizations providing telecommunication and radio engineering services, as well

	as roles in information and analytical departments, scientific institutions, and related fields. A specialist in telecommunications and radio engineering (graduate) is qualified to perform professional tasks as outlined in the State Classifier of Professions DK 003: 2010. **Professional roles a master's graduate can perform in the primary field of training:** Main role: 2144.2 - Engineer in information and telecommunication technologies. Additional roles: 2144.2 - Engineer in information and telecommunication systems. 2144.1 - Lecturer at a higher educational institution.
Further education	**Opportunities for further education** include pursuing studies at the third (educational and scientific) level of higher education in universities in Ukraine and abroad to obtain a Doctor of Philosophy (PhD) degree.
5 – Teaching and assessment	
Teaching and learning	**Teaching methods** include lectures, laboratory and practical classes, scientific and practical seminars, project-based learning (learning through projects), problem-oriented and on-demand learning, student-centered approaches, distance and blended learning, independent work and self-study, internships, and preparation of qualification work.
Assessment	**Assessment methods** include current and final knowledge evaluation (quizzes, control and individual assignments, testing, etc.), assessments and examinations (oral and written), defense of educational and practical projects with presentations, and public defense of qualification work.
6– Software competencies	
Integral competence	The ability to solve research and innovative problems in the field of electronic communications and radio engineering.
General competences	**GC1.** Ability for abstract thinking, analysis, and synthesis. **GC2.** Ability to apply knowledge in practical situations. **GC3.** Knowledge and understanding of the subject area and professional activities. **GC4.** Ability to communicate effectively in the national language, both orally and in writing. **GC5.** Ability to communicate in a foreign language. **GC6.** Proficiency in using information and communication technologies. **GC7.** Ability to conduct research at an appropriate level. **GC8.** Ability to search for, process, and analyze information from various sources. **GC9.** Ability to develop and manage projects. **GC10.** Ability to assess and ensure the quality of work performed.

Professional competencies of the specialty (defined by the standard of higher education of the specialty)	**SC1.** Ability to apply scientific facts, concepts, theories, principles, and methodologies of scientific research. **SC2.** Ability to implement the principles of a systems approach when conducting research on processes occurring in electronic communication and radio engineering systems, complexes, and devices. **SC3.** Ability to reasonably select and effectively apply mathematical methods, computer modeling technologies, as well as approaches and methods for optimizing electronic communication and radio engineering systems, complexes, technologies, devices, and their components at all stages of their life cycle. **SC4.** Ability to solve problems related to ensuring reliability, survivability, immunity, information security, and bandwidth of electronic communication and radio engineering systems, considering economic, legal, security, and other aspects. **SC5.** Ability to develop, improve, and use modern software, hardware, and integrated hardware-software solutions for electronic communication and radio engineering devices, systems, and complexes. **SC6.** Ability to protect intellectual property and comply with legal and ethical standards concerning intellectual property. **SC7.** Ability to find and evaluate information on electronic communications, radio engineering, and related topics. **SC8.** Ability to solve complex professional tasks using the latest technologies for transmitting, receiving, and processing information. **SC9.** Ability to address current scientific problems in the field of electronic communications and radio engineering with the justified use of modern theoretical and experimental research methods. **SC10.** Ability to carry out scientific and pedagogical activities in institutions of higher education.
7 – Program learning outcomes	
Program learning outcomes in the specialty (defined by the standard of higher education of the specialty)	**According to the results of training, graduates acquire the following skills and abilities in the specialty:** **LO1.** Organize their own professional, research, and innovative activities based on the principles of a systems approach and scientific research methodology. **LO2.** Take into account social, moral, and ethical norms; establish effective teamwork during scientific research and project implementation. **LO3.** Develop and implement modern and advanced electronic communication and radio engineering systems, complexes, technologies, devices, and their components. **LO4.** Plan and conduct scientific and applied research in the field of electronic communications and radio engineering, apply mathematical and physical modeling methods, process information, interpret research results, and justify conclusions.

	LO5. Identify relevant scientific and applied problems, perform their theoretical analysis, propose and justify approaches and methods for solving them, conduct technical and economic substantiation, and formulate specific research goals. **LO6.** Analyze development trends and the latest standards in the field of electronic communications and radio engineering. **LO7.** Localize and assess the state of problem situations at the stages of research, design, modernization, implementation, and operation of modern and advanced electronic communication and radio engineering systems, complexes, technologies, devices, and their components; propose solutions to eliminate identified deficiencies. **LO8.** Apply general and specialized programming languages, analytical and simulation modeling tools, as well as software and hardware development tools to solve complex problems in electronic communications and radio engineering. **LO9.** Protect intellectual property, develop relevant protective documents, analyze patent clearance, and ensure compliance of scientific research and development with Ukrainian legislation and international intellectual property standards. **LO10.** Ensure reliability, survivability, immunity, information security, and bandwidth of electronic communication and radio engineering systems. **LO11.** Develop and implement engineering projects considering objectives, constraints, and social, economic, legal, and environmental aspects. **LO12.** Manage complex production and operational processes and ensure the professional development of personnel. **LO13.** Analyze technical (tactical and technical) characteristics of communication and radio engineering systems, market needs, investment climate, and competitiveness of project solutions, scientific research, and development projects. **LO14.** Search for information in scientific and technical reference literature, patents, databases, and other sources; analyze and evaluate this information. **LO15.** Communicate in a foreign language, both orally and in writing, at a level sufficient for presenting and discussing professional activities, research, and projects in electronic communications and radio engineering, searching for and analyzing scientific and technical information, and clearly and unambiguously conveying thoughts and arguments. **LO16.** Identify and solve current scientific problems in the field of electronic communications and radio engineering, and choose and apply effective theoretical and experimental research methods.

	LO17. Conduct individual classes in educational disciplines of electronic communications and radio engineering in higher education institutions.
8 – Resource support for program implementation	
Staff support	Meets the personnel requirements for ensuring the implementation of educational activities in the field of higher education in accordance with the current legislation of Ukraine (Cabinet of Ministers Resolution "On Approval of Licensing Conditions for the Implementation of Educational Activities by Educational Institutions" dated December 30, 2015, No. 1187, Appendix 12).
Material and technical support	Meets the requirements for material and technical support necessary for the implementation of educational activities in the field of higher education in accordance with the current legislation of Ukraine (Cabinet of Ministers Resolution "On Approval of Licensing Conditions for the Implementation of Educational Activities by Educational Institutions" dated December 30, 2015, No. 1187, Appendix 13).
Informational and educational and methodological support	Meets the requirements for informational and educational-methodological support necessary for the implementation of educational activities in the field of higher education in accordance with the current legislation of Ukraine (Cabinet of Ministers Resolution "On Approval of Licensing Conditions for the Implementation of Educational Activities by Educational Institutions" dated December 30, 2015, No. 1187, Appendix 14).
9 – Academic mobility	
National credit mobility	Based on bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and leading technical universities of Ukraine, there is also the potential for establishing agreements (such as Erasmus+) to facilitate academic mobility and dual degree programs. - Donetsk National Technical University; - Kherson National Technical University; - Odessa National Polytechnic University; - Prykarpattia National University named after Vasyl Stefanyk; - Kyiv National University of Construction and Architecture; - Kyiv National University named after Taras Shevchenko; - State University of Telecommunications; - Chernivtsi National University named after Yu. Fedkovych; - Mykhailo Ostrogradsky Kremenchug National University; - Kyiv National University of Culture and Arts.

International credit mobility	Based on bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and higher education institutions in foreign partner countries, international academic mobility agreements (Erasmus+) have been established with the following universities: - Deusto University (Bilbao, Spain); - Mining and Metallurgical Academy named after Stanislava Staszyca (Krakow, Poland); - University of Applied Sciences "FH JOANNEUM" Gesellschaft MBH (Graz, Austria); - Vytautas the Great University (Kaunas, Lithuania); - Bucharest Polytechnic University (Bucharest, Romania); - Czech University of Natural Sciences (Prague, Czech Republic); - Carinthian University of Applied Sciences (Villach, Austria).
Education of foreign students of higher education	Allows foreign citizens to study. It is planned to teach foreign students in English.

2. LIST OF EDUCATIONAL PROGRAM COMPONENTS AND THEIR LOGICAL SEQUENCE

2.1 List of EP components

Code	Components of the educational program (Courses, projects / works, practice, qualification work)	Value of credits of ECTS	Final control form
1	**2**	**3**	**4**
MANDATORY COMPONENTS OF THE EDUCATIONAL PROGRAM			
1.1.General training			
GT1	Innovative entrepreneurship and startup project management	3	Credit (1)
GT2	Intellectual property	3	Credit (1)
GT3	Foreign language by professional direction	3	Credit (2)
1.2.Special (professional) training			
ST1	TCS system and software	4	Exam (1)
ST2	Global computer networks	5	Credit (2)
ST3	Basics of scientific research	4	Exam (1)
ST4	Systems modeling methods	5	Exam (2)
ST5	Optimization of digital telecommunication networks	5	Exam (2)
ST6	Research work	4	Credit (2)
The total amount of mandatory components		**60**	
2. Practical training			
PP	Pre-diploma practice	15	Credit (3)
A	Attestation (Defense of the Master's Thesis)	15	Defending (3)
3. Elective Courses			
3.1. Elective Courses for Specialized Training (according to the list)			
EST 1-3	Elective Course for Specialized Training	4	Exam (1)
EST 4-6	Elective Course for Specialized Training	4	Exam (2)
EST 7-9	Elective Course for Specialized Training	4	Exam (2)
EST 10-12	Elective Course for Specialized Training	4	Credit (1)
EST 13-15	Elective Course for Specialized Training	4	Exam (1)
EST 16-18	Elective Course for Specialized Training	4	Credit (1)
Total Volume of Elective Components		**30**	
Total Volume of the Educational Program		**90**	

3. FORM OF ATTESTATION OF HIGHER EDUCATION APPLICANTS

The attestation of graduates of the educational program in the specialty 172 "Electronic Communications and Radio Engineering" is conducted in the form of a public defense of a master's qualification thesis. It culminates in the issuance of a standard document certifying the award of the master's degree with the qualification: "Master in Electronic Communications and Radio Engineering".

The attestation process is conducted openly and publicly. The qualification thesis is checked for plagiarism in accordance with the "Regulations on the Prevention of Academic Plagiarism at the National Technical University 'Kharkiv Polytechnic Institute'."

Matrix of Correspondence Between the Competencies/Learning Outcomes Defined by the Standard and the NQF Descriptors Table 1

Classification of Competencies (Learning Outcomes) According to the NQF	**Knowledge** **Kn1.** Specialized conceptual knowledge that includes contemporary scientific achievements in the field of professional activity or area of knowledge, serving as a basis for original thinking and research. **Kn2.** Critical understanding of issues in the field and at the intersection of fields of knowledge.	**Skills** **Sk1.** Specialized skills for problem-solving, necessary for conducting research and/or engaging in innovative activities to develop new knowledge and procedures. **Sk2.** Ability to integrate knowledge and solve complex tasks in broad or multidisciplinary contexts. **Sk3.** Ability to solve problems in new or unfamiliar environments with incomplete or limited information, considering aspects of social and ethical responsibility.	**Communication** **C1**. Clear and unambiguous communication of personal knowledge, conclusions, and arguments to specialists and non-specialists, including learners	**Responsibility and Autonomy** **RA1.** Management of work or educational processes that are complex, unpredictable, and require new strategic approaches. **RA2.** Responsibility for contributions to professional knowledge and practice and/or for evaluating the results of team and collective activities. **RA3**. Ability to continue learning with a high degree of autonomy.
General competences				
GC1	Kn1	Sk2	C1	RA3
GC2		Sk1		RA2
GC3		Sk1		RA1
GC4		Sk1		RA1
GC5		Sk1		RA1
GC6		Sk1		RA1
GC7		Sk3		RA3
GC8		Sk1		RA3
GC9		Sk1		RA2
GC10		Sk1		RA2
Special (professional, courses) competences				
SC1	Kn1	Sk1	C1	RA1
SC2	Kn2	Sk2		RA3
SC3	Kn1	Sk1		RA2
SC4	Kn2	Sk2		RA2
SC5	Kn1	Sk1		RA1
SC6	Kn1	Sk1		RA2
SC7	Kn2	Sk2		RA1
SC8	Kn1	Sk3		RA1
SC9	Kn1	Sk3		RA3
SC10	Kn1	Sk3		RA1
Professional competences of specialization (defined by the institution of higher education)				
LO1 –LO17	Kn2	Sk3	C1	RA3

Table 2

Correspondence matrix of learning outcomes and competencies defined by the Standard

Learning outcomes	Competences																			
	Integral competence																			
	General competences										Special (professional, course) competences									
	GC1	GC2	GC3	GC4	GC5	GC6	GC7	GC8	GC9	GC10	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10
LO1		+							+			+								
LO2				+		+										+				
LO3	+		+								+									
LO4							+				+		+						+	
LO5	+							+									+			
LO6								+									+			
LO7							+										+	+		
LO8	+														+					
LO9										+						+				
LO10		+												+						
LO11									+									+		
LO12			+															+		
LO13								+									+			
LO14					+			+									+			
LO15					+															
LO16							+												+	
LO17			+			+														+

Guarantor of the educational program,
professor of the department of information systems named after V.O. Kravets
National Technical University "Kharkiv Polytechnic Institute" **Vitalii BRESLAVETS**