

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"**

I APPROVE

Rector of NTU "KhPI"

_____ Evgen SOKOL

"09" _____ May 2023

EDUCATIONAL AND SCIENTIFIC PROGRAM

"Software Engineering"

Second (master's) level of higher education

in the specialty 121 - Software engineering
fields of knowledge 12 - Information technologies
Master's qualification in software engineering

APPROVED

**BY THE ACADEMIC COUNCIL OF NTU
"KhPI"**

Chairman of the Academic Council

_____ / Leonid TOVAZHNIANSKYI

Protocol No. 4

from "05" _____ May 2023

Kharkiv 2023

LETTER OF AGREEMENT

educational of the software engineering scientific program

The second level of higher education (master's)
Branch of knowledge 12 – Information technologies
Specialty 121 – Software engineering
Master's degree in software engineering

APPROVED

Working group of OP from the specialty
"Software engineering"

Guarantor of the "Software Engineering"
educational program

_____Ihor GAMAYUN
" ___ " _____ 2023

RECOMMENDED

Methodical Council of NTU "KhPI"

Deputy Chairman of the Methodical Council

_____Ruslan MYGUSHCHENKO
" ___ " _____ 2023

AGREED

Head of the Department of Software
Engineering and Intelligent Management
Technologies

_____Ihor GAMAYUN
" ___ " _____ 2023

AGREED

Director of the educational and scientific institute
of computer sciences and information
technologies

_____Mykhailo GODLEVSKYI
" ___ " _____ 2023

AGREED

Student (member of EP working group)
group KN-H222

_____Artem Lushyn
" ___ " _____ 2023

REVIEWERS: Productive comments and feedback on the project of the
educational and scientific program (ESP) were received from:

1. "TELESENSE" LLC
2. LLC "NIX SOLUTIONS LTD"
3. ACADEMY SMART LLC

PREFACE

Corresponds to the Standard of Higher Education of Ukraine of the second level (master's degree), field of knowledge 12 - Information technologies, specialty 121 - Software engineering approved by the order of the Ministry of Education and Science of Ukraine dated 11/17/2020 No. 1424.

Developed by the working group of the OPP "Software Engineering"
Educational and Scientific Institute of Computer Sciences and Information Technologies
of the National Technical University "Kharkiv Polytechnic Institute"
consisting of:

Guarantor of the educational program

Ihor Petrovych Gamayun, Doctor of Technical Sciences, Professor, Head of the
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OP working group members:

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2. Cherednichenko Olga Yuriivna, Doctor of Technical Sciences, Associate Professor,
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3. Oleksandr Vitaliyovych Shmatko, Candidate of Technical Sciences, Associate
Professor, Associate Professor of the Department of Software Engineering and
Intelligent Management Technologies
(name, scientific degree, academic title, position)
4. Artem Valeriyovych Lushin, student of group KN-N222
student (name, group)

1. PROFILE OF THE EDUCATIONAL PROGRAM BY SPECIALTY

1 - General information	
Higher educational institution and structural unit	National Technical University "Kharkiv Polytechnic Institute", Educational and Scientific Institute of Computer Sciences and Information Technologies, Department of Software Engineering and Intelligent Management Technologies (SEMIT)
The degree of higher education and the title of the qualification in the original language	Degree of higher education: master's degree Educational qualification: Master's degree in software engineering Diploma Qualification: Master of Software Engineering
The official name of the educational program	Software engineering
Type of diploma and scope of the educational program	Master's degree, single, 120 ECTS credits, study period - 1 year 9 months
Availability of accreditation	Accreditation Commission. Ukraine. Certificate - ND No. 2192136. Validity period - 01.06.2025.
Cycle/level	Second (master's) level of higher education, NRK – 7th level, QF-LLL – 7th level, FQ-EHEA – second cycle
Prerequisites	Individuals who have obtained a bachelor's degree can apply for a master's degree.
Language of teaching	Ukrainian language. Teaching in English is possible.
The term of validity of the educational program	According to the validity period of the accreditation certificate Updated annually
Link to the permanent posting of the description of the educational program	http://web.kpi.kharkov.ua/asu/121-inzheneriya-programnogo-zabezpechennya-2/
2 - The purpose of the educational program	
The combination of a high level of professional training with the formation of a scientific worldview and the provision of a broad outlook in the social, humanitarian, fundamental spheres and in the field of software engineering. Achieving the specified goal is based on the principles of continuity and individualization of education, fundamentality and integrity of knowledge provision, practical orientation and awareness of the place of acquired competences, symbiosis of scientific and systemic approaches, etc.	
3 – Characteristics of the educational program	
Subject area (field of knowledge, specialty, specialization)	Field of knowledge: 12 - Information technologies Specialty: 121 – Software engineering Object of study and activity: processes of development, modification, analysis, quality assurance, implementation and maintenance of software. Training goals: training of specialists who are able to solve complex tasks and problems in the development, quality assurance, implementation and support of software tools, which involves conducting research and/or implementing innovations and is characterized by uncertainty of conditions and requirements. Theoretical content of the subject area: basic mathematical, infological, linguistic, economic conceptual provisions regarding the development and maintenance of software and ensuring its quality. Methods, techniques and technologies: methods of analysis and modeling of the application area, identification of information needs, classification and analysis of data for software design; methods of developing software requirements; methods of analysis and construction of software models; methods of software design,

	<p>construction, integration, testing and verification; methods of modifying software components and data; reliability and quality models and methods in software engineering; software project management methods.</p> <p>Tools and equipment: software, hardware and cloud tools to support software engineering processes.</p>
Orientation of the educational program	<p>Educational-professional and educational-scientific master's programs are designed for students who aspire to become specialists in the field of engineering and scientific activities in the field of software engineering. The main advantage of the master's training program is the orientation towards the formation of the broadest possible scientific and technical outlook of the future professional.</p>
The main focus of the educational program and specialization	<p>General:</p> <ul style="list-style-type: none"> - familiarization with modern methods of effective access to information, its collection, systematization and preservation; - the main paradigms of design and software development of computerized systems; - methods of software life cycle planning and resource management model development; - basic protocols of the Internet, models of Internet services; - methods of designing informational WEB resources with integration of external data and software products, using information protection methods. <p>Special:</p> <ul style="list-style-type: none"> - providing training and obtaining in-depth knowledge for the effective use of new information and communication technologies in various subject areas of industry, education, and IT enterprises; - acquisition of stable skills regarding the use of modern communication technologies, virtualization technologies, storage and processing of large data sets in the development of modern information systems used in the innovative activities of enterprises and business structures; - acquisition of decision-making skills based on the methods of modern management theory of complex systems and management objects using computing intelligence technologies. <p>Keywords: software, information technology, software engineering</p>
Features programs	<p>Orientation on partnership with domestic and foreign educational and scientific institutions, the private sector, scientists and practitioners, participation in international programs.</p> <p>Dual form of education, which involves practice in IT companies and students' participation in real projects.</p>
4 – Suitability of graduates for employment and further education	
Suitability for employment	<p>Professional activity as a software engineer; software engineer; system programmer; database programmer; web programmer; system administrator; information systems support engineer; software development and testing specialist.</p> <p>Graduates can work in professions according to the National Classifier of Professions DK 003:2010:</p> <p>2131.2 Computer software engineer 2132.2 Software engineer 2132.2 Programmer (database) 2132.2 System programmer 2131.2 Software and multimedia analyst</p>

	<p>2132.2 Applied programmer 2149.2 Research engineer 3121.2 Specialist in information technologies 3121.2 Specialist in software development and testing 3121.2 Computer program development specialist</p>
Further education	The opportunity to study at a third-level educational and scientific program (Doctor of Philosophy - PhD) according to the National Framework of Qualifications of the field of knowledge "Information Technologies" or related fields of knowledge.
5 – Teaching and assessment	
Teaching and learning	Student-centered learning, problem-oriented learning, distance learning in the Office 365 system, self-learning, learning through project practice, learning based on research. Lectures, laboratory classes, work in small groups, seminars-discussions, practical classes, practical scientific research works are used for teaching.
Assessment	<p>Monitoring of students' knowledge and skills is carried out in the form of current and final control.</p> <p>Current control – oral and written survey, assessment of work in small groups, testing, defense of group and individual research tasks and projects.</p> <p>Final control - oral and written exams, assessments taking into account the accumulated points of the current control, defense of practical reports, defense of term papers.</p> <p>State certification – preparation and public defense (presentation) of the final qualification work.</p> <p>Evaluation is carried out according to the national scale ("excellent", "good", "satisfactory", "unsatisfactory"), 100-point scale and ECTS scale (A, B, C, D, E, FX, F).</p> <p>Control of students' knowledge and skills is carried out in the form of current and final control. Evaluation of the student's educational achievements is carried out according to the rating system.</p> <p>Current control includes control of students' knowledge, abilities, and skills in lectures, laboratory and practical classes, and during the performance of individual educational tasks and tests.</p> <p>Assessment of students' knowledge of a certain discipline is carried out within the classroom hours allocated to it. At the end of each semester, in addition to the assessment of students' knowledge by discipline, an assessment of practical skills and research work is conducted. Final control is carried out in the form of exams, assessments and certification of higher education applicants.</p> <p>Attestation is carried out in the form of a public defense (demonstration) of the qualification work (in the form of a diploma project). The qualification work must include elements of scientific research and practical nature.</p> <p>The institution of higher education carries out a mandatory check for plagiarism of all master's qualification works. The uniqueness of the content for the works of the educational and scientific training program should be at least 70%.</p>
6 – Software competencies	
Integral competence	A person's ability to solve complex tasks and problems in a certain field of professional activity or in the process of learning, which involves conducting research and/or implementing innovations and is characterized by the uncertainty of conditions and requirements.

<p>General competences (defined by the standard of higher education of the specialty)</p>	<p>GC01. Ability to abstract thinking, analysis and synthesis. GC02. Ability to communicate in a foreign language both orally and in writing. GC03. Ability to conduct research at an appropriate level. GC04. Ability to communicate with representatives of other professional groups of different levels (with experts of other fields of knowledge/types of economic activity). GC05. Ability to generate new ideas (creativity).</p>
<p>Special (professional) competences of the specialty (defined by the standard of higher education of the specialty)</p>	<p>PC01. Ability to analyze subject areas, form, classify software requirements. PC02. Ability to develop and implement scientific and/or applied projects in the field of software engineering. PC03. The ability to design software architecture, to model the functioning processes of individual subsystems and modules. PC04. Ability to develop and implement new competitive ideas in software engineering. PC05. Ability to develop, analyze and apply specifications, standards, rules and recommendations in the field of software engineering. PC06. Ability to effectively manage financial, human, technical and other project resources in the field of software engineering. PC07. Ability to think critically about problems in the field of information technology and at the boundaries of fields of knowledge, integrate relevant knowledge and solve complex problems in broad or multidisciplinary contexts. PC08. Ability to develop and coordinate processes, stages and iterations of the software life cycle based on the application of modern software development models, methods and technologies. PC09. Ability to ensure software quality. Additionally for educational and scientific programs: PC10. Ability to plan and perform scientific research on software engineering. PC11. Ability to apply and develop fundamental and interdisciplinary knowledge to successfully solve scientific problems of software engineering.</p>
<p>7 - Learning outcomes</p>	
<p>The results of studies in the specialty (defined by the standard of higher education of the specialty)</p>	<p>LO01 Know and apply modern professional standards and other regulatory and legal documents on software engineering PH02 Evaluate and choose effective methods and models of software development, implementation, maintenance and management of relevant processes at all stages of the life cycle. PH03 Build and research models of information processes in the applied field. LO04 Identify information needs and classify data for software design. LO05 Develop, analyze, justify and systematize software requirements. LO06 Develop and evaluate software design strategies; substantiate, analyze and evaluate options for project solutions from the point of view of the quality of the final software product, resource limitations and other factors. LO07 Analyze, evaluate and apply modern software and hardware platforms at the system level to solve complex software engineering problems.</p>

	<p>LO08 Develop and modify software architecture to meet customer requirements.</p> <p>LO09 Reasonably choose programming paradigms and languages for software development; apply modern means of software development in practice.</p> <p>LO10 Modify existing and develop new algorithmic solutions for detailed software design.</p> <p>LO11 Ensure quality at all stages of the software life cycle, including using relevant models and evaluation methods, as well as means of automated software testing and verification.</p> <p>LO12 Make effective organizational and management decisions in conditions of uncertainty and changing requirements, compare alternatives, assess risks.</p> <p>LO13 Configure software, manage its changes and development of software documentation at all stages of the life cycle.</p> <p>LO14 Forecast the development of software systems and information technologies.</p> <p>LO15 Reengineering the software in accordance with the customer's requirements.</p> <p>LO16 Plan, organize and carry out software testing, verification and validation.</p> <p>LO17 Collect, analyze, evaluate information necessary for solving scientific and applied problems, using scientific and technical literature, databases and other sources.</p> <p>Additionally for educational and scientific programs:</p> <p>LO18 Develop mathematical and software for scientific research in the field of software engineering.</p> <p>LO19 Formulate, experimentally verify, substantiate and apply in practice innovative methods and competitive technologies for solving professional, scientific and technical problems in multidisciplinary contexts in the process of software development.</p> <p>LO20 Plan and carry out scientific research in the field of software engineering, choose methods and tools, analyze results, justify conclusions.</p>
8 – Resource support for program implementation	
Staff support	<p>Personnel provision of the National Academy of Sciences corresponds to the Resolution of the Cabinet of Ministers of Ukraine No. 1187 of 12/30/2015 "On approval of the Licensing conditions for conducting educational activities of educational institutions" (as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine No. 365 of 24/03/2021. Appendix 15-16).</p> <p>The educational process is provided by scientific and pedagogical workers who work at the main place of work and have appropriate educational and/or professional qualifications. Practical teachers, specialists and employees of IT companies, foreign experts are also involved in teaching.</p>
Material and technical support	<p>The material and technical support of the EPT corresponds to the Resolution of the Cabinet of Ministers of Ukraine No. 1187 dated 30.12.2015 "On approval of the Licensing conditions for conducting educational activities of educational institutions" (as amended in accordance with Resolution of the Cabinet of Ministers of Ukraine No. 365 of 24.03.2021 Appendix 17).</p> <p>In the educational process, educational facilities of NTU "KhPI" are used, in particular, computer laboratories and educational laboratory</p>

	"Innovation Campus" of the SEMIT department, premises for scientific and pedagogical workers, other premises.
Informational and educational and methodological support	The informational and educational and methodological support of EPT complies with the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 "On Approval of Licensing Conditions for Conducting Educational Activities of Educational Institutions" (as amended in accordance with Resolution of the Cabinet of Ministers of Ukraine No. 365 dated 24.03.2021. Appendix 18) . Application of the Office 365 system, LMS (Learning Management System) in the educational process, in particular, for distance learning. Access to the electronic repository (eNTUKhPIIR) of the scientific and technical library of NTU "KhPI" via the Internet (including the university Wi-Fi network) for access to educational publications and periodical scientific publications on IT, in particular, in English.
9 – Academic mobility	
National credit mobility	Based on bilateral agreements on academic mobility with institutions of higher education within Ukraine.
International credit mobility	Based on an agreement with Université Paris-Nord (University of Paris-North, France), Univerza v Mariboru (University of Maribor, Slovenia). Academic mobility projects ERASMUS+ KA1.
Education of foreign students of education	Training of foreign citizens and stateless persons is carried out in Ukrainian or English in accordance with the requirements of the Law of Ukraine "On Higher Education". At least 25% of scientific-pedagogical staff who ensure the implementation of the educational process in English have a document certifying English language proficiency at a level not lower than B2 in accordance with the Common European Recommendations on Language Education: Study, Teaching, Evaluation (Common European Framework of Reference for Languages, CEFR).

LIST OF EDUCATIONAL COMPONENTS OF THE EDUCATIONAL PROGRAM AND THEIR LOGICAL SEQUENCE

<i>Code n/a</i>	<i>Components of the educational program</i>	<i>Number of credits</i>	<i>Final control form</i>
1	2	3	4
<i>1 Mandatory educational components</i>			
<i>1.1 General preparation</i>			
<i>GT 1</i>	Foreign language by professional direction	4	Test
<i>GT 2</i>	English for scientific purposes	4	Exam
<i>GT 3</i>	Intellectual Property	3	Test
<i>GT 4</i>	Innovative entrepreneurship and startup project management	3	Test
		14	
<i>1.2 Special (professional) training</i>			
<i>PT 1</i>	Software of intelligent systems	5	Test
<i>PT 2</i>	Formal methods of software systems research	3	Exam
<i>PT 3</i>	Fundamentals of designing intelligent systems	3	Exam
<i>PT 4</i>	Scientific school of the department	3	Exam
<i>PT 5</i>	Project management in software engineering	4	Exam
<i>PT 6</i>	Decision support models and methods	4	Exam
<i>PT 7</i>	Models and technologies for ensuring the security of intelligent systems	3	Exam
<i>PT 8</i>	Introduction to DevOps	3	Test
<i>PT 9</i>	Big Data	3	Test
		31	
<i>1.3 Scientific training</i>			
<i>ST 1</i>	Basics of the scientific research	3	Test
<i>ST 2</i>	Modern directions of research in software engineering	4	Test
<i>ST 3</i>	Philosophical problems of modern scientific knowledge (MSK)	3	Exam
<i>ST 4</i>	R&D	6	Test
<i>ST 5</i>	Scientific research practice	14	Test
	Certification	9	
		39	
<i>The total amount of mandatory components</i>		84	
<i>2 Elective educational components</i>			
<i>2.1 Professional training</i>			
<i>Profiled package of disciplines 01 "Project Management in Software Engineering"</i>			
<i>OP 1.1</i>	Analysis and management of requirements	5	Test
<i>OP 1.2</i>	Project management	5	Test
<i>OP 1.3</i>	Innovation and entrepreneurship	5	Test
<i>Profiled package of disciplines 02 "Cloud Computing"</i>			
<i>OP 2.1</i>	Databases and data warehouses	5	Test
<i>OP 2.2</i>	Intelligent data analysis and knowledge extraction	5	Test

<i>Code n/a</i>	<i>Components of the educational program</i>	<i>Number of credits</i>	<i>Final control form</i>
<i>OP 2.3</i>	Cloud Computing: cloud technologies and applications	5	Test
<i>Profiled package of disciplines 03 "Artificial intelligence and Machine Learning"</i>			
<i>OP 3.1</i>	Intelligent data analysis and knowledge extraction	5	Test
<i>OP 3.2</i>	Multi-agent systems and technologies	5	Test
<i>OP 3.3</i>	Neural networks and methods of computational intelligence	5	Test
		15	
<i>2.2 Disciplines of free choice of specialized training according to the list (the list of disciplines is attached to the curriculum)</i>			
<i>OD 1</i>	Analytical data warehouses	3	Test
<i>OD 2</i>	Cloud Computing: cloud technologies and applications	3	Test
<i>OD 3</i>	Group dynamics and communications	3	Test
<i>OD 4</i>	Distributed and parallel computing	3	Test
<i>OD 5</i>	Modern programming technologies	3	Test
<i>OD 6</i>	Decentralized applications and blockchain technology	3	Test
<i>OD 7</i>	Data Integration and Cleaning (ETL) Tools	3	Test
<i>OD 8</i>	Models of artificial intelligence	3	Test
		3	
<i>2.3 Legal and psychological disciplines according to the list (the list of disciplines is attached)</i>		6	
<i>2.4. Disciplines of free choice of scientific and professional direction (NPS)</i>		12	
<i>The total amount of sample components:</i>		36	
<i>GENERAL SCOPE OF THE EDUCATIONAL PROGRAM:</i>		120	

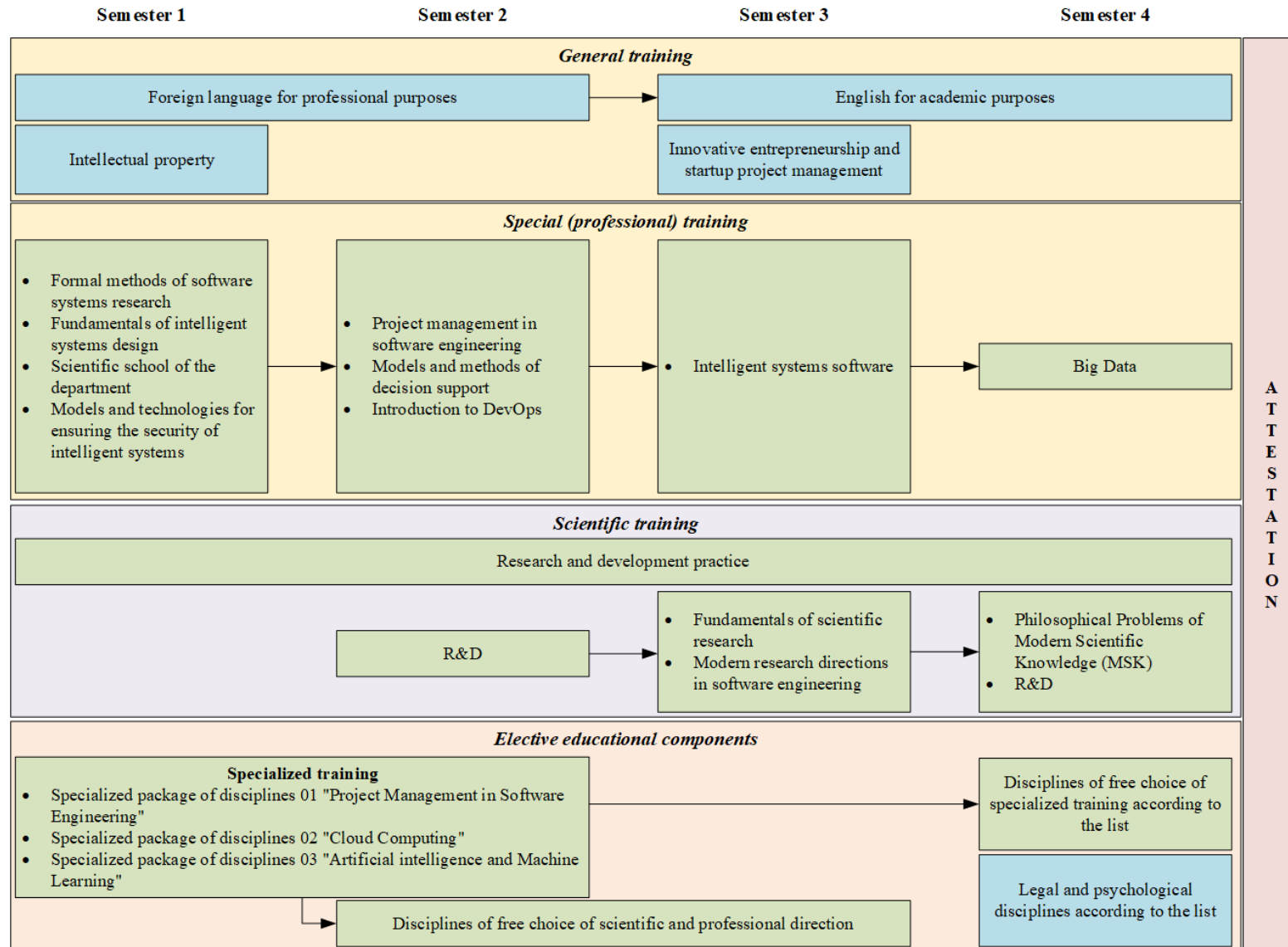
Distribution of the content of the educational program by component groups and training cycles

No	Training cycle	The volume of the educational load of the student of higher education (ECTS credits / %)		
		Mandatory components of the educational and scientific program	Elective components of the educational and scientific program	Total for the entire period of study
1	General training	14 / 12	-	14 / 12
2	Special (professional) training	31 / 26	-	31 / 26
3	Scientific training	39 / 32		39 / 32
4	Disciplines of free choice	-	36 / 30	36 / 30
Total for the entire period of study		84 / 70	36 / 28	120 / 100

FORM OF CERTIFICATION OF HIGHER EDUCATION ACQUIRES

Forms of attestation of applicants of higher education	Attestation of master's degree holders is carried out in the form of a public defense of the qualification work.
Requirements for qualifying work	<p>The qualifying work must solve a complex software engineering problem or problem and involve research and/or innovation.</p> <p>The qualifying work should not contain academic plagiarism, fabrication, or falsification. The qualification work must be published on the official website of the institution of higher education or its subdivision, or in the repository of the institution of higher education.</p> <p>The publication of qualifying works with limited access is carried out in accordance with the requirements of the law.</p>

STRUCTURAL AND LOGICAL SCHEME



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Correspondence matrix of defined learning outcomes, competencies and educational components

Program learning outcomes	Competences															
	General competences					Special (professional) competences										
	GC01	GC02	GC03	GC04	GC05	PC01	PC02	PC03	PC04	PC05	PC06	PC07	PC08	PC09	PC10	PC11
LO01	+	+								+		+		+		
LO02	+							+		+		+		+		
LO03	+														+	
LO04	+	+		+		+										
LO05	+			+		+									+	
LO06	+						+	+		+	+	+			+	
LO07	+						+	+	+	+	+					
LO08	+				+	+	+	+		+					+	
LO09	+								+	+					+	
LO10	+				+		+		+	+						
LO11	+					+				+			+	+		
LO12	+									+	+	+				
LO13	+							+		+		+			+	
LO14	+								+	+		+			+	
LO15	+	+														
LO16	+	+	+		+		+	+	+							
LO17	+	+	+	+												+
LO18	+		+	+	+	+									+	+
LO19	+	+	+	+	+		+		+						+	+
LO20	+	+		+											+	+