

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE  
“IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE”**

**APPROVED**

by the Academic Council

of Igor Sikorsky Kyiv Polytechnic Institute

(protocol № 10 dated 13.12.2021)

Chairman of the Academic Council

Mykhailo ILCHENKO

**Software Engineering of Multimedia and  
Information Retrieval Systems  
EDUCATIONAL AND SCIENTIFIC PROGRAM  
Second level of higher education (Master level)**

<b>Specialty</b>	<b>121 Software Engineering</b>
<b>Field of Study</b>	<b>12 Information Technologies</b>
<b>Qualification</b>	<b>Master in Software Engineering</b>

Entered into force since 2022/2023  
year by order of the Igor Sikorsky  
Kyiv Polytechnic Institute rector  
from 15.02.2022 № HOH/75/2022

## **PREAMBLE**

**DEVELOPED** by the project group:

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**Sulema Yevheniia Stanislavivna,**

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Doctor of Technical Sciences, Associate Professor

**AGREED:**

The Scientific and Methodological Commission of the University  
on specialty 121 Software Engineering

Chairman of the SMCU 121 Ivan DYCHKA

(protocol № 3 dated 02.12.2021)

The Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute

Chairman of the Methodological Council Anatolii MELNYCHENKO

(protocol № 2 dated 09.12.2021)

## **TAKE INTO ACCOUNT:**

### **Professional examination was conducted:**

Andrii PECHERSKYKH - Head of Business Technology Center LLC

Serhii ROZHOK - General Director of LLC EPAM Systems IT Company

Georgiy CHERNYSHOV – Resource director of LLC CQGI Ukraine

Standard of Higher Education in the specialty 121" Software Engineering "in the field of knowledge 12" Information Technology "for the second (master's) level of higher education, approved by the Order of the Ministry of Education and Science of Ukraine 17.11.2020 № 1424

Changes to the National Classifier DK 003:2010 <https://mon.gov.ua/ua/npa/pro-zatverdzhennya-zmini-10-do-nacionalnogo-klasifikatora-dk-0032010>

Changes to the approved Licensing Conditions for Educational Activities dated December 30, 2015 №1187, made in accordance with the Resolution of the Cabinet of Ministers <https://zakon.rada.gov.ua/laws/show/1187-2015-%D0%BF#Text>

The Educational program was discussed after receiving all the wishes and suggestions from students and graduates of the Educational program and approved at an extended meeting of the Department of Computer Systems Software (protocol № 5 dated 10.11.2021).

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# 1. PROFILE OF THE EDUCATIONAL PROGRAM

## Program Subject Area 121 Software Engineering

<b>1 – General Information</b>	
Full name of the higher education institution and institute / faculty	National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” (Igor Sikorsky Kyiv Polytechnic Institute). Faculty of Applied Mathematics
Degree of higher education and title of qualification in the original language	Master Degree Qualification – Software Engineering
The official name of the educational program	Software Engineering of Multimedia and Information Retrieval Systems
Type of diploma and scope of educational program	Diploma of Master, single, 120 credits, term of study 1 year, 9 months
Availability of accreditation	Ministry of Education and Science of Ukraine Certificate of Accreditation НД № 1192620 The certificate is valid until 01.07.2023
Cycle / level of higher education	NQF of Ukraine – 7 level, QF-EHEA – the second cycle, EQF-LLL – 7 level
Prerequisites	To obtain the educational level "Master" in the specialty 121 "Software Engineering" in the field of study 12 "Information Technology" can be accepted persons who have obtained the educational level "Bachelor". The program of professional entrance examinations for persons who have obtained a previous level of higher education in other specialties should include verification of the acquisition of competencies and learning outcomes defined by the standard of higher education in specialty 121 "Software Engineering" for the first (bachelor's) level of higher education.
Term of the educational program	Until the next accreditation.
Language (s) of instruction	Ukrainian, English
Internet address of the permanent placement of the educational program	Published on sites: <a href="https://osvita.kpi.ua">https://osvita.kpi.ua</a> (section "Educational programs") <a href="http://fpm.kpi.ua">http://fpm.kpi.ua</a> <a href="http://pzks.fpm.kpi.ua">http://pzks.fpm.kpi.ua</a>

## 2 – The Purpose of the Educational Program

The purpose of the educational program is to train specialists in the field of software engineering, in particular software engineering of multimedia and information retrieval systems, capable of solving complex scientific and technical, innovation-oriented problems and problems of software engineering of multimedia and information retrieval systems, capable of formulating production and scientific tasks for software development, maintenance and quality assurance, to find rational and optimal methods and means of their solution, to solve complex specialized problems and practical scientific problems in software engineering, to ensure sustainable development of IT companies, as well as training of applicants higher education to further study in the chosen specialty.

The purpose of the educational program corresponds to the development strategy of Igor Sikorsky Kyiv Polytechnic Institute for 2020-2025 on the formation of the society of the future on the basis of the concept of sustainable development.

## 3 – Characteristics of the Educational Program

Subject industry	<ul style="list-style-type: none"><li>- <i>Object of study and activity:</i> processes of development, modification, analysis, quality assurance, implementation and maintenance of software.</li><li>- <i>The goals of the educational and scientific program "Software engineering of multimedia and information retrieval systems"</i> are specialists training who are in demand on the international and national labor markets and can ensure the sustainable development of the economy both in the IT and related areas, in particular, they are able to formulate and solve complex development problems, quality assurance, software tools implementation and support, which involves conducting research and/or innovation and is characterized by uncertainty of conditions and requirements..</li><li>- <i>Theoretical content of the subject area:</i> basic mathematical, infological, linguistic, economic conceptual provisions for the development and maintenance of software and quality assurance.</li><li>- <i>Methods, techniques and technologies:</i> 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 designing, designing, integrating, testing and verifying software; methods of modification of software components and data; models and methods of reliability and quality in software engineering; methods of software project management.</li><li>- <i>Tools and equipment:</i> software and hardware and cloud tools to support software engineering processes.</li></ul>
Orientation of the educational program	Educational and scientific.

<p>The main focus of the educational program</p>	<p>The educational program provides special education in the field of software engineering of multimedia and information retrieval systems. The program is aimed at the formation of such competencies of higher education students that make possible their comprehensive professional, scientific, intellectual and social development in the field of software engineering of multimedia and information retrieval systems. The program provides the acquisition of educational qualifications for the formulation of complex tasks of scientific and professional activities and their implementation. Applicants for higher education have the opportunity to acquire knowledge from other fields and deepen their knowledge in the field of software engineering of multimedia and information retrieval systems, thanks to the possibility of forming a flexible individual learning trajectory.</p> <p>Keywords: software, software tools, multimedia systems, information retrieval systems, specialized software, computer systems, information technology, development, maintenance and quality assurance of software.</p>
<p>Features of the program</p>	<p>A special feature of the program is the training of specialists who are able to design information and search systems using artificial intelligence technologies. The program uniqueness is in the combination of professional training in software engineering with educational and scientific training in processing natural language texts, developing multimedia interfaces and using Mulsemedia technology, which has recently been dynamically developing and is one of the elements of such cutting-edge technologies as Metaverse and Digital Humans , forming a new segment of the software market. Specialized equipment of the Educational and Scientific Laboratory of Multimedia, Mulsemedia and Immersion Technologies can be used for educational and scientific training of students.</p> <p>The program provides the practicing professionals involvement from leading IT companies who develop the software in the educational process.</p> <p>Students and teachers of the educational program have the opportunity to participate in international academic mobility programs.</p> <p>In addition, the educational program is based on international professional standards of software engineering and IT project management, which are used in the software development of international level.</p>

<b>4 – Suitability of Graduates for Employment and Further Study</b>	
Suitability for employment	<p>Area of professional activity is software development, technologies and software development tools, research, teaching, expert and consulting activities in the field of software engineering.</p> <p>Masters in Software Engineering can work as specialists in software design, development and testing in the field of information technology. According to the National Classification of Occupations SC 003:2010, graduates can work in the following professions:</p> <p>2131.2 Database administrator;  2131.2 Data Administrator;  2131.2 Access Administrator;  2131.2 System administrator;  2131.2 Computer Communications Analyst;  2131.2 Software and Multimedia Analyst;  2131.2 Computer Software Engineer;  2131.2 Software Engineer;  2131.2 Programmer (database);  2131.2 Programmer (applied);  2132.1 Junior Researcher (Programming)  2132.1 Researcher (programming)  2132.1 Researcher-consultant (programming)  2132.2 Software Engineer  2132.2 Programmer (database)  2132.2 Application programmer  2132.2 System programmer  2139.2 Computer Application Engineer.</p>
Further training	<p>Opportunity to continue education at the third (educational and scientific) level of higher education.</p> <p>Acquisition of additional qualifications in the adult education system.</p>



<b>5 – Teaching and Assessment</b>	
Teaching and learning	<p>The program provides for student-centered learning, a competency-based approach, as well as the implementation of problem-oriented learning technology. Learning style - active, which allows the graduate to choose subjects and organize time.</p> <p>General learning style - task-oriented. Information and communication technologies (e-learning, online lectures) are used during the training.</p> <p>Forms of training: lectures, practical and seminar classes, computer workshops and laboratory work; course projects and works; technology of blended learning, practice and excursions; independent work on the basis of textbooks and abstracts, consultations with teachers. During the first semester of study, the undergraduate chooses the direction of research. During the second, third and the fourth semesters, the undergraduate performs a master's thesis, which the undergraduate presents and defends before the examination board.</p> <p>All participants in the educational process are provided with timely and understandable information on the goals, content and program learning outcomes, the procedure and evaluation criteria within the individual educational components.</p>
Assessment	Assessment of students' knowledge is carried out in accordance with the Regulation on the system of assessment of student learning outcomes of Igor Sikorsky Kyiv Polytechnic Institute for all types of classroom and non-classroom work.
<b>6 – Program Competencies</b>	
Integral competence	Ability to solve complex specialized tasks or scientific and innovative problems of software engineering of multimedia and information retrieval systems, which involves conducting research with elements of scientific novelty and / or innovation in conditions of uncertainty.
<b>General Competencies (GC)</b>	
GC 1	Ability to abstract thinking, analysis and synthesis.
GC 2	Ability to communicate in a foreign language both orally and in writing.
GC 3	Ability to conduct research at the appropriate level.
GC 4	Ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity).
GC 5	Ability to generate new ideas (creativity).
<b>Professional Competencies of the Specialty (PC)</b>	
PC 1	Ability to analyze subject areas, form, classify software requirements.
PC 2	Ability to develop and implement scientific and / or applied projects in the field of software engineering.
PC 3	Ability to design software architecture, model the operation of individual subsystems and modules.
PC 4	Ability to develop and implement new competitive ideas in software engineering.
PC 5	Ability to develop, analyze and apply specifications, standards, rules and guidelines in the field of software engineering.
PC 6	Ability to effectively manage financial, human, technical and other project resources in the field of software engineering.

PC7	Ability to critically comprehend problems in the field of information technology and at the frontiers of knowledge, to integrate relevant knowledge and solve complex problems in broad or multidisciplinary contexts.
PC8	Ability to develop and coordinate processes, stages and iterations of the software life cycle based on the application of modern models, methods and technologies of software development.
PC9	Ability to ensure software quality.
PC10	Ability to plan and perform research in software engineering.
PC11	Ability to apply and develop fundamental and interdisciplinary knowledge to successfully solve scientific problems of software engineering.
PC12	Ability to design complex multimedia and information retrieval systems.
PC13	Ability to design and construct, implement and maintain web-based software systems to implement new information retrieval methods.
PC14	Ability to implement and maintain information systems.
PC15	Ability to develop and implement software projects, including in-house research, that enables the solution of significant technical, social, scientific, cultural, ethical and other problems.
PC16	Ability to apply artificial intelligence technologies for designing information and search systems.
PC17	Ability to apply software engineering methodologies in practice.
PC18	Ability to apply acquired fundamental knowledge for the software development for automatic identification systems.
PC19	Ability to design multimedia software interfaces.
PC20	Ability to develop and apply methods and algorithms for making optimal decisions, solve complex optimization problems using software.
<b>7 – Program Learning Outcomes (PLO)</b>	
PLO01	Know and apply modern professional standards and regulations on software engineering.
PLO02	Evaluate and choose effective methods and models of software development, implementation, support and relevant processes management at all stages of the life cycle.
PLO03	Build and research models of information processes in the application field.
PLO04	Identify information needs and classify data for software design.
PLO05	Develop, analyze, justify and systematize software requirements.
PLO06	Develop and evaluate software design strategies; substantiate, analyze and evaluate options for design solutions in terms of the final software product quality, resource constraints and other factors.
PLO07	Analyze, evaluate and apply at the system level modern software and hardware platforms to solve complex problems of software engineering.
PLO08	Develop and modify software architecture to meet customer requirements.
PLO09	Choose reasonable paradigms and programming languages for software development; apply modern software development tools in practice.
PLO10	Modify existing and develop new algorithmic solutions for detailed software design.
PLO11	Ensure quality at all stages of the software life cycle, including the use of relevant models and assessment methods, as well as automated software testing and verification tools.

PLO12	Make effective organizational and managerial decisions in conditions of uncertainty and changing requirements, compare alternatives, assess risks.
PLO13	Configure software, manage its changes and develop software documentation at all stages of the life cycle.
PLO14	Predict the development of software systems and information technology.
PLO15	Carry out software reengineering in accordance with customer requirements.
PLO16	Plan, organize and perform software testing, verification and validation.
PLO17	Collect, analyze, evaluate the information needed to solve scientific and applied problems, using scientific and technical literature, databases and other sources.
PLO18	Develop mathematical and software for research in software engineering.
PLO19	Formulate, experimentally test, substantiate and apply in practice in the process of software development innovative methods and competitive technologies for solving professional, scientific and technical problems in multidisciplinary contexts.
PLO20	Plan and perform research in the software engineering area, choose methods and tools, analyze the results, justify the conclusions.
PLO21	Know the theoretical foundations underlying research methods of information systems and software, research methodologies and computational experiments.
PLO22	Be able to represent research results in the form of articles in scientific journals and abstracts of reports at scientific and technical conferences.
PLO23	Know the principles of building software information retrieval systems.
PLO24	Be able to modify existing and develop new methods and algorithms for classification and clustering of data, taking into account the characteristics of the subject area.
PLO25	Be able to modify existing and develop new methods and algorithms for searching multimedia data in information retrieval systems, taking into account the characteristics of the subject area.
PLO26	Know and be able to apply in practice specialized templates for designing information retrieval systems.
PLO27	Be able to design and develop multi-agent information retrieval systems.
PLO28	Be able to design and develop distributed and centralized information retrieval systems.
PLO29	Know and be able to use the means of information compression of alphanumeric data.
PLO30	Know and be able to use the ensuring interference resistance methods in the software development for automatic identification systems.
PLO31	Be able to implement innovative projects in the field of software engineering of multimedia and information retrieval systems from idea to implementation in the software market.
PLO32	Be able to develop multimedia systems and interfaces.
PLO33	Be able to develop software for 3D visualization systems.
PLO34	Know the approaches, directions, models and methods of artificial intelligence, including machine learning; know the technology of software development of artificial intelligence systems, apply artificial intelligence methods in research and to solve applied problems.
PLO35	Know the software methods of operations research and mathematical programming.

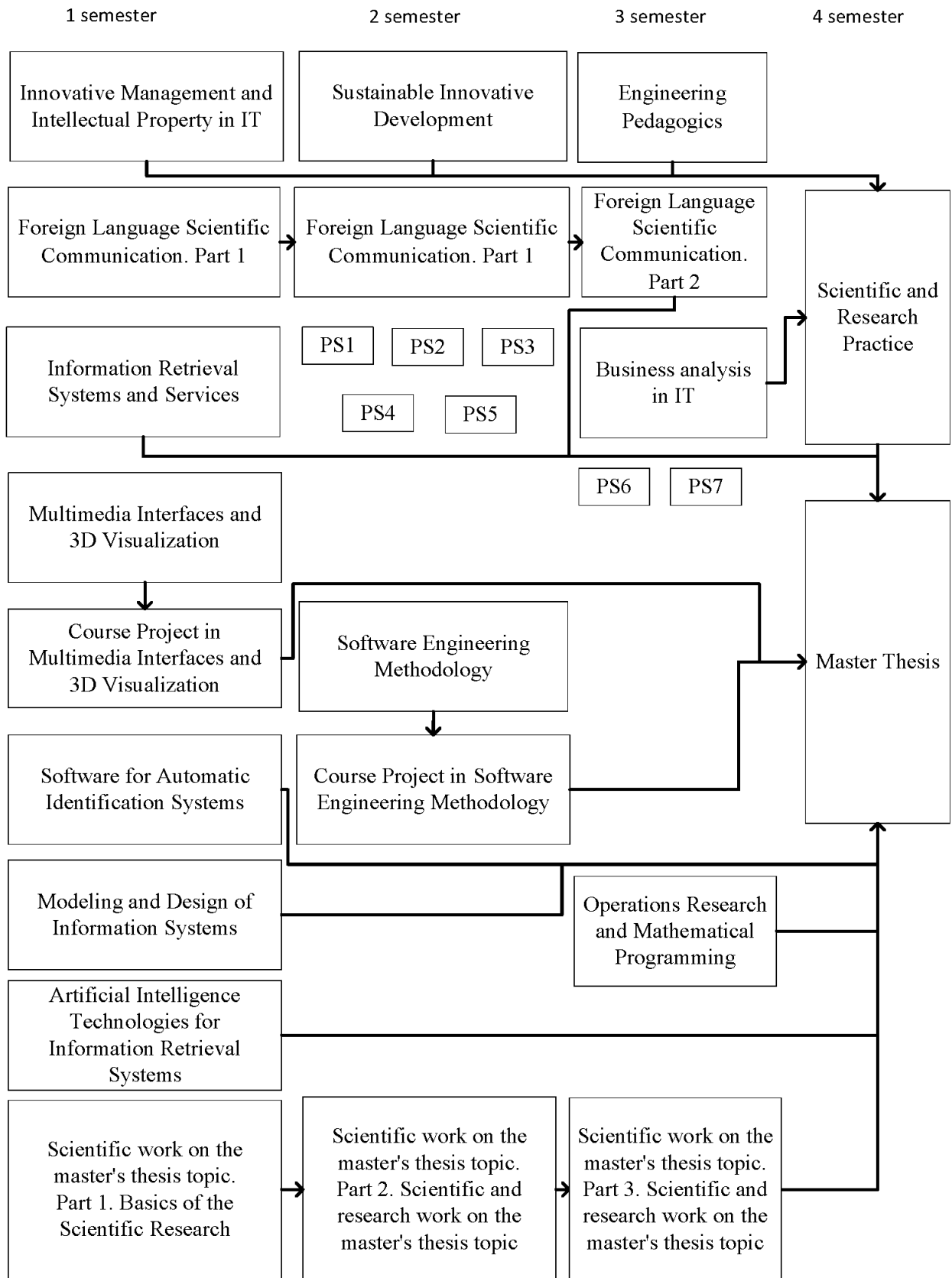
<b>8 – Resource Support for Program Implementation</b>	
Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the relevant level of higher education, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current version. Involvement of specialists from the international IT company EPAM Systems.
Material and technical support	In accordance with the technological requirements for material and technical support of educational activities of the relevant level of higher education, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 №1187 in the current version. Conducting laboratory classes, course and diploma projects in the educational and scientific laboratory "EPAM-KPI", educational and scientific laboratory of multimedia, multimedia and immersion technologies, specialized laboratory of the international project MEDIS.
Information and educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the relevant level of higher education, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 №1187 in the current version. Use of the Igor Sikorsky Kyiv Polytechnic Institute Scientific and Technical Library, educational, methodical and informational resources provided by the Department of Computer Systems Software.
<b>9 – Academic Mobility</b>	
National credit mobility	Possibility of concluding agreements on academic mobility, double diplomacy.
International credit mobility	Agreements on international academic mobility (Erasmus + KA1) have been concluded with universities: 1. Melardalen University (Sweden). 2. University of Malta (Malta). 3. Lotharingia University – Loria Lab (France).
Training of foreign applicants for higher education	Training of foreign citizens for higher education who master the educational program in international academic mobility programs, training may be conducted in English or Ukrainian, provided that the applicant speaks the learning language at a level not lower than B2.

## 2. LIST OF THE EDUCATIONAL PROGRAM COMPONENTS

Code	Components of the educational program (academic disciplines, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
<b>1. NORMATIVE Educational Components</b>			
<b>1.1. General Training Cycle</b>			
GE1	Innovative Management and Intellectual Property in IT	4,5	credit
GE2	Sustainable Innovative Development	2	credit
GE3.1	Foreign Language Scientific Communication. Part 1	3	credit
GE3.2	Foreign Language Scientific Communication. Part 2	1,5	credit
GE4	Engineering Pedagogics	2	credit
GE5	Business Analysis in IT	4	exam
<b>1.2. Cycle of Professional Training</b>			
PE4	Software Engineering Methodology	4	credit
PE5	Course Project in Software Engineering Methodology	1,5	credit
PE6	Modeling and Design of Information Systems	4	exam
PE7	Information Retrieval Systems and Services	5	exam
PE8	Software for Automatic Identification Systems	4	exam
PE9	Multimedia Interfaces and 3D Visualization	4	credit
PE10	Course Project in Multimedia Interfaces and 3D Visualization	1	credit
PE11	Artificial Intelligence Technologies for Information Retrieval Systems	4	credit
PE12	Operations Research and Mathematical Programming	7	exam
<b>Research (Scientific) Component</b>			
PE1.1	Scientific work on the master's thesis topic. Part 1. Basics of the Scientific Research	2	credit
PE1.2	Scientific work on the master's thesis topic. Part 2. Scientific and research work on the master's thesis topic	2	credit
PE1.3	Scientific work on the master's thesis topic. Part 3. Scientific and research work on the master's thesis topic	7,5	credit
PE2	Scientific and Research Practice	10	credit
PE3	Master Thesis	16	thesis defense
<b>2. SELECTIVE Educational Components</b>			
<b>2.1. Cycle of Professional Training (Selective Educational Components from Faculty / Department Catalogs)</b>			
PS1	Educational component 1 of the F-Catalog	4	credit

1	2	3	4
PS2	Educational component 2 of the F-Catalog	4	credit
PS3	Educational component 3 of the F-Catalog	5	exam
PS4	Educational component 4 of the F-Catalog	5	exam
PS5	Educational component 5 of the F-Catalog	5	exam
PS6	Educational component 6 of the F-Catalog	4	credit
PS7	Educational component 7 of the F-Catalog	4	credit
<b>Required components</b> total amount:		89	
<b>Selective components</b> total amount:		31	
<b>Educational components that ensure the acquisition of competencies defined by the Standard of Higher Education</b> total amount:		48	
<b>EDUCATIONAL PROGRAM TOTAL VOLUME</b>		<b>120</b>	

### 3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



## **4. FORM OF FINAL CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION**

Final certification of applicants for higher education under the educational and scientific program "Software Engineering of Multimedia and Information Retrieval Systems", Program Subject Area "Software Engineering" is conducted in the form of public defense of the qualification work and ends with the issuance of a standard document on awarding a master's degree in software engineering.

Qualification work should solve a complex problem or problem of software engineering and involve research and innovation. The qualification work is checked for plagiarism and after the defense is placed in the repository of the Scientific and Technical Library of the University for free access.



## 5. MATRIX OF COMPLIANCE OF PROGRAM COMPETENCIES WITH COMPONENTS OF THE EDUCATIONAL PROGRAM

	GE1	GE2	GE3	GE4	GE5	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE11	PE12
GC1		+			+	+	+	+	+								
GC2			+														
GC3	+					+	+	+									
GC4	+	+	+	+	+	+	+										
GC5	+	+		+		+	+	+									
PC1					+		+	+	+	+	+						
PC2							+	+		+	+				+		
PC3							+	+	+	+	+	+	+				
PC4							+	+									
PC5							+	+	+			+					
PC6	+						+	+	+								
PC7		+			+	+	+	+	+							+	
PC8					+		+	+	+	+	+		+				
PC9							+	+	+								
PC10						+	+	+			+	+			+		
PC11						+	+	+								+	+
PC12												+		+	+		
PC13												+				+	
PC14											+	+					
PC15															+		
PC16																+	
PC17									+	+	+				+		
PC18													+				
PC19														+	+		
PC20																	+

## 6. MATRIX OF PROVIDING PROGRAM LEARNING OUTCOMES BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	GE1	GE2	GE3	GE4	GE5	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE11	PE12
PLO01							+	+	+	+							
PLO02							+	+	+	+	+						
PLO03					+		+	+	+	+	+					+	+
PLO04					+		+	+	+	+	+	+		+	+	+	
PLO05					+		+	+	+	+			+		+		
PLO06					+	+	+	+	+	+	+						+
PLO07							+	+	+	+	+		+	+	+	+	
PLO08							+	+	+	+	+		+		+		
PLO09							+	+	+	+			+		+		
PLO10							+	+	+	+	+				+		
PLO11							+	+	+	+	+						
PLO12	+				+		+	+									+
PLO13								+	+	+	+				+		
PLO14		+				+		+	+								+
PLO15									+		+				+		
PLO16								+	+	+			+		+	+	
PLO17			+	+		+	+	+	+	+	+					+	+
PLO18						+					+	+	+				+
PLO19	+						+	+					+			+	
PLO20						+	+	+			+						
PLO21									+		+	+	+				+
PLO22			+			+											
PLO23												+					
PLO24																+	
PLO25													+				
PLO26											+	+					
PLO27												+					
PLO28												+					
PLO29													+	+			
PLO30													+				
PLO31	+				+												
PLO32														+	+		
PLO33														+	+		
PLO34																+	
PLO35																	+