APPROVED by
Scientific Council of Igor Sikorsky KPI
(protocol № ____ of «___» _____ 2020)

Head of Scientific Council

_____ Mykhailo ILCHENKO

Software Engineering
EDUCATIONAL AND SCIENTIFIC PROGRAM

Third level of higher education (PhD level)

Specialty   **121 Software Engineering**

Field of Study   **12 Information Technologies**

Qualification   **Doctor of Philosophy in Software Engineering**

Entered into force by order of the
Igor Sikorsky Kyiv Polytechnic
Institute rector from
_____ № _____

Kyiv – 2020

PREAMBLE

DEVELOPED by the project group:

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AGREED:

Scientific Methodical Commission of Igor Sikorsky Kyiv Polytechnic Institute
for specialty 121 Software Engineering

Head of SMC _____ Ivan DYCHKA

(protocol № ____ of «____» _____ 2020)

Methodical Council of Igor Sikorsky Kyiv Polytechnic Institute

Head of MC _____ Yurii YAKYMENKO

(protocol № ____ of «____» _____ 2020)

TAKE INTO ACCOUNT:

Comments and suggestions of stakeholders based on the results of public discussion:

- scientific and pedagogical staff of the Computer Systems Software Department;
- applicants for higher education who study in the educational program of the specialty 121 Software Engineering;
- specialists of the educational and methodical department of Igor Sikorsky KPI;
- Software Engineering specialists (reviews and letters of support are attached).

Professional examination was conducted:

Serhii ROZHOK – The Director-General of EPAM Systems IT Company

Andrii PECHERSKYKH – The Director of Ltd "Center of Business Technology"

CONTENTS

1. PROFILE OF THE EDUCATIONAL PROGRAM

Specialty 121 Software Engineering

1 – General Information	
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	Degree – Doctor of Philosophy Qualification – Doctor of Philosophy in Software Engineering
The official name of the educational program	Software Engineering
Type of diploma and scope of educational program	Diploma of Doctor of Philosophy, educational – 40 credits ECTS, term of study 4 years. The scientific component involves conducting your own research and design of its results in the form of a dissertation.
Availability of accreditation	Accreditation is scheduled for 2021
Cycle / level of higher education	NQF of Ukraine – 9 level QF-EHEA – the third cycle EQF-LLL – 8 рівень
Prerequisites	Second level of higher education (master level).
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: https://osvita.kpi.ua (section "Educational programs") http://fpm.kpi.ua (section "Faculty information package") http://pzks.fpm.kpi.ua (section "Educational programs") http://fiot.kpi.ua (section "Educational programs") https://acts.kpi.ua/ (section "Educational programs") https://comsys.kpi.ua/ (section "Educational programs") http://tc.kpi.ua/uk/ (section "Educational programs") http://asu.kpi.ua/ (section "Educational programs") https://tef.kpi.ua/rub_6.htm http://apeps.kpi.ua/opponp
2 – The Purpose of the Educational Program	

The purpose of the educational program is to train highly qualified, competitive, integrated into the European and world scientific and technical space specialists of the degree of Doctor of Philosophy in Software Engineering capable of independent research, scientific-innovative, organizational-managerial, pedagogical activity in the field of technical sciences in specialty 121 Software Engineering and related fields in higher education institutions, by internalizing the educational process in terms of sustainable innovative scientific and technological development of society and is implemented through:

- harmonious and multidimensional education of future highly qualified technicians, able to comprehensively and systematically analyze the problems of software engineering and related industries, aware of the nature of surrounding processes and phenomena, to provide and conduct intercultural communication;

- formation of high adaptability of higher education seekers in the conditions of labor market transformation through interaction with employers and other stakeholders.

The purpose of the educational program corresponds to the development strategy of Igor Sikorsky KPI 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 area	*Object*: theoretical and methodological principles of requirements analysis, design, construction, verification, validation and maintenance of software systems *The purpose of training*: training of software engineering specialists capable of solving complex problems in the field of professional and / or research and innovation in the field of information technology, which involves a deep rethinking of existing and the creation of new holistic knowledge and / or professional practice. *Theoretical content of the subject area*: basic and applied research, development and implementation of theories and technologies of software engineering, the possibility of their use for practical purposes. *Methods, techniques and technologies*: objective methods of phenomenologization, systematization, adjustment of previously obtained and creation of new knowledge in Software Engineering. *Tools and equipment*: ware and hardware and cloud tools to support software engineering processes.
Orientation of the educational program	Educational and scientific
The main focus of the educational program	Special education focused on research in the field of software engineering. Keywords: software, computer systems, information technology, software engineering, software development, maintenance and quality assurance, information retrieval systems.
Features of the program	Teaching a number of disciplines in English
4 – Suitability of Graduates for Employment and Further Study	
Suitability for employment	Doctors of Philosophy in Software Engineering can work as specialists in the design, development and testing of software in the field of information technology. According to the National Classification of Occupations DK 003:2010, graduates can work in the following professions: 2132.1 Junior researcher (programming) 2132.1 Researcher (programming) 2132.1 Researcher-consultant (programming) 2310 Teachers of universities and higher educational institutions
Further training	Continuing education in doctoral studies and/or participation in postdoctoral programs
5 – Teaching and Assessment	
Teaching and learning	Problem-oriented learning with the acquisition of competencies necessary for the production of new ideas, solving complex problems in the professional field, which includes lectures, practical and seminar classes, computer workshops and laboratory work; blended learning technology, pedagogical practice, preparation and defense of dissertation.
Assessment	Rating system, assessment, oral and written exams, tests, testing

6 – Program Competencies	
Integral competence	Ability to solve complex problems in the field of professional and/or research and innovation activities in the field of software engineering, which involves a deep rethinking of existing and the creation of new holistic knowledge and/or professional practice.
General Competencies (GC)	
GC1	Ability to adhere to research ethics, as well as the rules of academic integrity in research and scientific and pedagogical activities.
GC2	Ability to abstract thinking, analysis and synthesis.
GC3	Ability to search, process and analyze information from various sources.
GC4	Ability to develop and manage projects.
GC5	Ability to critically analyze, evaluate and synthesize new and complex ideas
GC6	Ability to rethink existing and create new holistic knowledge and / or professional practice and to solve significant social, scientific, cultural, ethical and other problems
GC7	Ability to develop and implement projects, including own research
GC8	Ability to initiate and implement innovative complex projects in software engineering, leadership during their implementation.
GC9	Ability to use in general professional basic knowledge of various sciences
GC10	Ability to find, process and analyze the necessary information for problem solving and decision making
GC11	Ability to use modern methods and technologies of scientific communication in Ukrainian and foreign languages
GC12	Ability to ensure continuous self-development and self-improvement, responsibility for the development of others
GC13	Ability to use adequate methods of effective interaction with representatives of different groups (social, cultural and professional)
GC14	Ability to work in a team, form positive relationships with colleagues, communicate with the wider scientific community and the public in the field of software engineering.
Professional Competencies of the Specialty (PC)	
PC1	Ability to perform original research, achieve scientific results that create new knowledge in software engineering and related interdisciplinary areas and can be published in leading scientific journals in information technology and related fields.
PC2	Ability to orally and in writing present and discuss the results of research and / or innovative developments in Ukrainian and English, a deep understanding of English scientific texts in the field of research
PC3	Ability to critically rethink existing software engineering technologies and track trends in their development.
PC4	Ability to develop new and improve existing models, methods, tools, processes in the field of software engineering, which provide the development or provide new opportunities for technology development and use of software.
PC5	Ability to independently perform research activities in software engineering using modern concepts, methods and technologies.
PC6	Ability to apply formal methods of design, development and research of software systems and technologies in scientific research.
PC7	Ability to think creatively, to generate new progressive ideas in software engineering.

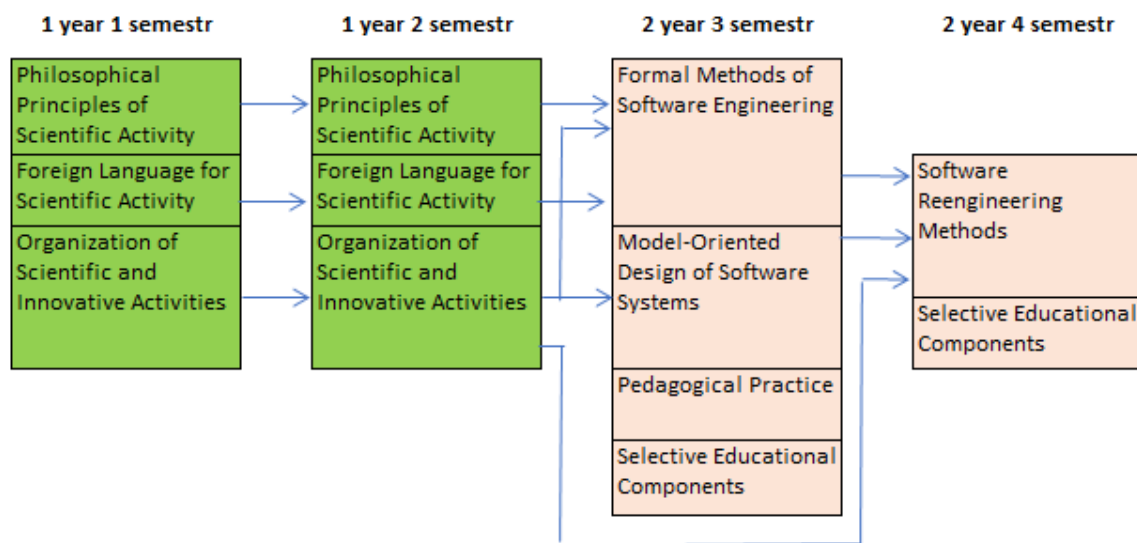| PC8	Ability to develop new models and scientific methods of software design, development and research.
PC9	Ability to conduct experimental studies to evaluate the effectiveness and security of software.
PC10	Ability to develop high-quality and reliable software for complex software packages and systems based on the latest technologies and software development standards.
PC11	Ability to develop technical documentation for research projects.
PC12	Ability to design scientific reports and publications on scientific research in accordance with existing standards and in accordance with the norms of academic integrity.
PC13	Ability to integrate software modules for management and decision making into existing information systems and complexes.
PC14	Ability to critically analyze, evaluate and synthesize new and complex ideas in software engineering.
PC15	Ability to develop and implement software projects, including own research, which provide an opportunity to rethink existing and create new holistic knowledge and solutions to significant technical, social, scientific, cultural, ethical and other problems.
PC16	Ability to continuous self-improvement in the professional sphere, responsibility for teaching others in conducting scientific and pedagogical activities and research in software engineering.
PC17	Ability to make strategic decisions that anticipate and formulate future directions for the development of customer-oriented processes, new business products and services.
PC18	Ability to set tasks, program basic machine learning algorithms and conduct experiments in solving problems of large data analysis.
PC19	Ability to perform pre-processing of data using the studied general means of data extraction; to search for new useful data and their relationships; to verify the models built on the basis of the obtained useful data; to the correct interpretation of the results obtained in decision-making
7 – Program Learning Outcomes (PLO)	
PLO1	Have advanced conceptual and methodological knowledge in software engineering and at the subject line, as well as research skills sufficient to conduct scientific and applied research at the level of the latest world achievements in the field, gain new knowledge and / or innovate.
PLO2	Freely present and discuss with specialists and non-specialists the results of research, scientific and applied problems of software engineering in state and foreign languages, qualified to reflect the results of research in scientific publications in leading international scientific journals.
PLO3	Develop and research conceptual, mathematical and computer models of processes and systems, effectively use them to gain new knowledge and / or create innovative products in software engineering and related interdisciplinary areas.
PLO4	Deeply understand the general principles and methods of software engineering sciences, as well as research methodology, apply them in their own research in the field of software engineering and in teaching practice.
PLO5	Be able to investigate the operating parameters of software life cycle processes, as well as to analyze the selected methods and tools to support these processes and be able to justify their choice.

PLO6	Understand the theoretical foundations underlying research methods of information systems and software, research methodologies and computational experiments.
PLO7	Be able to formulate and solve problems of optimization, adaptation, forecasting, management and decision-making on processes, tools and resources for software development, implementation, maintenance and operation.
PLO8	Know modern technologies of automated design and verification of programs.
PLO9	Be able to apply, develop and improve methods of automated software design.
PLO10	Be able to apply, develop and improve software verification methods.
PLO11	Be able to create a technological environment for a computer model of an information system.
PLO12	Know the effective mechanisms and methodologies of project planning, organization and management.
PLO13	Know how to manage and analyze large amounts of data.
PLO14	Know the methodologies of computer modeling of complex systems.
PLO15	Know the methodologies of visual modeling of complex systems.
PLO16	Know the principles of building scenario models and verification of information analysis scenarios.
PLO17	Be able to develop and improve methods of model-oriented design of information systems to solve theoretical and applied problems, provided the creation of object, scenario models and models of rank management systems.
PLO18	Be able to design information systems, developing and applying software for computer modeling of information systems, provided the solution of modeling problems.
PLO19	Know the methods of software reengineering.
PLO20	Know the methodologies for building the technological environment of the computer model of the information system.
PLO21	Be able to responsibly manage projects, apply modern methods of project management to solve practical problems in professional activities, use project management software.
PLO22	Be able to develop and improve methods of designing software architecture based on cloud, mobile and web technologies.
8 – Resource Support for Program Implementation	
Staffing	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 (current) version of 23.05.2018 №347. Involvement of specialists from the international IT company EPAM Systems.
Material and technical 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 (current) version of 23.05.2018 №347. Conducting classes in: 1. Educational and scientific laboratory "EPAM-KPI", educational and scientific laboratory of multimedia,

	multimedia and immersion technologies, specialized laboratory of the international project MEDIS. 2. Ukrainian-Korean Center of Information Technologies (UKCIT) (agreement between NTUU "KPI" and the Korean Agency for International Cooperation COISA on the establishment of the Ukrainian-Korean Center of Information Technologies in NTUU "KPI"). 3. Accantum GMBH Virtual Training Center and Software Solutions Competence Center. 4. Cisco Academy Department of Computer-Aided Management and Data Processing Systems (CAMDPS) of Igor Sikorsky Kyiv Polytechnic Institute. 5. Samsung Research and Training Laboratory; 6. Hewlett-Packard Research and Training Laboratory. 7. Joint with the German company Helasoft (Hamburg) research and training laboratory. There is a variant of remote information retrieval and interaction with teachers.
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 (current) version of 23.05.2018 №347. During the teaching scientific works in the field of software engineering, materials on specialized portals, webinars, presentations, articles in professional publications are used. The University provides applicants with access to information resources and electronic repository by the Scientific and Technical Library. G.I. Denisenko Igor Sikorsky Kyiv Polytechnic Institute for the organization of scientific research, free access to the Internet tools of the scientist ORCID, Scopus, Web of Science, etc., author's developments of scientific and pedagogical staff of the university. Educational and methodical support: educational and scientific program, curricula, working programs in academic disciplines.
9 – Academic Mobility	
National credit mobility	Possibility of concluding agreements on academic mobility.
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. International Credit Mobility University of Malaga (Kingdom of Spain) PhD preparation agreements and research agreements with the Institutes of the Academy of Sciences of Shandong Province (China).
Training of foreign applicants for higher education	For foreign citizens, education is provided in English, and Ukrainian is studied as a foreign language.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (academic disciplines, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
1. NORMATIVE Educational Components			
N1	Philosophical Principles of Scientific Activity	6	credit, exam
N2	Foreign Language for Scientific Activity	6	credit, exam
N3	Formal Methods of Software Engineering	4	exam
N4	Model-Oriented Design of Software Systems	4	exam
N5	Software Reengineering Methods	4	exam
N6	Organization of Scientific and Innovative Activities	4	credit, exam
N7	Pedagogical Practice	2	credit
2. SELECTIVE Educational Components			
S1	Educational component 1 of the F-Catalog	5	credit
S2	Educational component 2 of the F-Catalog	5	credit
Required components total amount:		30	
Selective components total amount:		10	
EDUCATIONAL PROGRAM TOTAL VOLUME		**40**	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM

1 year 1 semestr	1 year 2 semestr	2 year 3 semestr	2 year 4 semestr
Philosophical Principles of Scientific Activity	Philosophical Principles of Scientific Activity	Formal Methods of Software Engineering	Software Reengineering Methods
Foreign Language for Scientific Activity	Foreign Language for Scientific Activity	Model-Oriented Design of Software Systems	Selective Educational Components
Organization of Scientific and Innovative Activities	Organization of Scientific and Innovative Activities	Pedagogical Practice	
		Selective Educational Components	

4. SCIENTIFIC COMPONENT

Year training	The content of the graduate student's scientific work	Form of control
1 year	Choice and substantiation of the topic of own scientific research, determination of the content, terms of performance and volume of scientific works; selection and substantiation of the methodology of own research, review and analysis of existing views and approaches that have developed in modern science in the chosen field. Preparation and publication of at least 1 article (usually a review) in scientific professional publications (domestic or foreign) on the research topic; participation in scientific and practical conferences (seminars) with the publication of abstracts.	Approval of the individual plan of the graduate student's work at the academic council of the institute/faculty, reporting on the progress of the individual graduate student's plan twice a year.
2 year	Conducting own research under the guidance of the supervisor, which involves solving research problems through the use of a set of theoretical and empirical methods. Preparation and publication of at least 1 article in scientific professional publications (domestic or foreign) on the research topic; participation in scientific and practical conferences (seminars) with the publication of abstracts.	Reporting on the progress of the individual graduate student's plan twice a year.

Year training	The content of the graduate student's scientific work	Form of control
3 year	Analysis and generalization of the obtained results of own scientific research; substantiation of scientific novelty of the obtained results, their theoretical and / or practical significance. Preparation and publication of at least 1 article in scientific professional publications on the research topic; participation in scientific and practical conferences (seminars) with the publication of abstracts.	Reporting on the progress of the individual graduate student's plan twice a year.
4 year	Registration of scientific achievements of the post-graduate student in the form of the dissertation, summing up concerning completeness of coverage of results of the dissertation in scientific articles according to the current requirements. Implementation of the obtained results and receipt of supporting documents. Submission of documents for preliminary examination of the dissertation. Preparation of a scientific report for final certification (defense of the dissertation).	Reporting on the progress of the individual graduate student's plan twice a year. Providing an opinion on the scientific novelty, theoretical and practical significance of the dissertation results.

5. FORM OF FINAL CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Graduation certification of applicants for higher education in the educational-scientific program Software Engineering specialty 121 Software Engineering is carried out in the form of dissertation defense and ends with the issuance of a standard document on awarding the degree of Doctor of Philosophy with the qualification: Doctor of Philosophy in Software Engineering. Qualification work is checked for plagiarism and after the defense is placed in the repository of NTL University for free access. Graduation certification is carried out openly and publicly.

6. MATRIX OF COMPLIANCE OF SOFTWARE COMPETENCIES WITH COMPONENTS OF THE EDUCATIONAL PROGRAM

	N1	N2	N3	N4	N5	N6	N7	Scientific component
GC1	+					+		+
GC2	+							
GC3						+		+
GC4				+				
GC5						+		
GC6	+					+		
GC7						+		+
GC8				+	+			
GC9						+		
GC10						+		
GC11		+						
GC12		+						
GC13		+				+	+	
GC14							+	
PC1						+		+
PC2						+		+
PC3						+		+
PC4						+		+
PC5						+		+
PC6			+	+		+		+
PC7					+	+		+
PC8					+	+		+
PC9			+		+	+		+
PC10			+	+	+	+		+
PC11			+	+	+	+		+
PC12						+		+
PC13						+		
PC14						+		+
PC15					+	+		+
PC16					+		+	+
PC17								+
PC18			+					
PC19			+					

7. MATRIX OF PROVIDING SOFTWARE LEARNING RESULTS BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	N1	N2	N3	N4	N5	N6	N7	Scientific component
PLO1						+		+
PLO2		+				+		+
PLO3				+		+		+
PLO4	+			+		+	+	+
PLO5				+		+		+
PLO6			+	+		+		+
PLO7			+	+				+
PLO8			+					
PLO9			+					+
PLO10			+					+
PLO11				+				
PLO12								+
PLO13								+
PLO14				+				
PLO15								+
PLO16								+
PLO17								+
PLO18				+				
PLO19					+			+
PLO20				+				
PLO21								+
PLO22					+			+