MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LVIV POLYTECHNIC NATIONAL UNIVERSITY

«APPROVE»
Rector
of Lviv Polytechnic National University
_____ /Yurii BOBALO
«____» ____03____ 2025 y.

EDUCATIONAL AND SCIENTIFIC PROGRAM

«Computer Engineering»

LEVEL OF HIGHER EDUCATION   Third (educational and scientific)

QUALIFICATION   Philosophy Doctor degree in Computer Engineering

FIELDS OF KNOWLEDGE   F Information technologies

SPECIALTY   F7 Computer engineering

Considered and approved
by University Academic Board
in «25»   02   2025 y.
protocol № 20

Lviv 2025

LETTER OF AGREEMENT
of educational and scientific program

Level of higher education   the third (educational and scientific)
Field of knowledge   F *Information technologies*
Specialty   F7 *Computer engineering*
Qualification   Philosophy Doctor

DEVELOPED AND APPROVED

Scientific and methodical commission of
specialty F7 *Computer engineering*
Protocol № __1__

in « _11_ » ___02___ 2025 y.
Head of the SMC of specialty F7
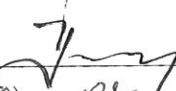*Computer engineering*

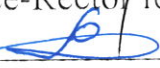_____Roman DUNETS

RECOMMENDED

Scientific and methodical commission of
University
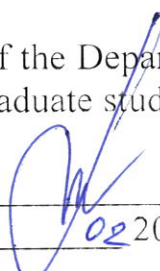Protocol № _85_
in «_20_» _02_ 2025 y.

Head of the SMC
_____Anatoliy ZAGORODNIJ

AGREED

Head of the Educational and Methodical
Department
_____Vasyl TOM`YUK
«_19_» _02_ 2025 y.

Vice-Rector for Scientific Research

_____ Ivan DEMYDOV
«_19_» _02_ 2025 y.

Vice-Rector for Graduate Education
_____ Oleh DAVYDCHAK
«_19_» _02_ 2025 y.

Head of the Department of Doctoral and
Post-graduate studies

_____ Olena MUKAN
«_19_» _02_ 2025 y.

Director of Institute of Computer
Technologies, Automation and
Metrology
_____Yurii KOSTIV
«_19_» _02_ 2025 y.

PREFACE

Developed by the working group in the specialty F7 Computer Engineering in the composition:

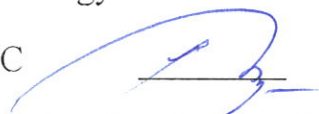|	
Roman DUNETS	DSc, prof., Head of the Department of Computer Engineering - guarantor
Roman KOCHAN	DSc, prof., Department of Specialized Computer Systems
Valerii HLUKHOV	DSc, prof., Department of Computer Engineering
Roman POPOVYCH	DSc, prof., Department of Specialized Computer Systems
Ivan OPIRSKYY	DSc, prof., Head of the Department of Information Security
Halyna KLYM	DSc, prof., Department of Specialized Computer Systems
Bohdan HAVANIO	PhD, associate professor, Department of Computer Engineering
Adrian MUZYCHENKO	graduate student, Department of Specialized Computer Systems
Bohdan RUSYN	DSc, prof., head of Department № 8 of information technologies of remote sounding Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine

Guarantor _____ Roman DUNETS

The draft educational and scientific program was discussed and approved by Scientific and methodical commission of the Institute of Computer Technologies, Automation and Metrology. Protocol №6 in « 20 » 02 2025 y.

Head of the SMC _____ Roman BAITSAR .

The draft educational and scientific program was discussed and approved by Institute of Computer Technologies, Automation and Metrology Academic Board. Protocol №7 in « 21 » 02 2025 y.

Head of the Academic Board _____ Yurii KOSTIV.

Approved and put into effect by the Rector's Order of the Lviv Polytechnic National University in «11» 03 2025 y. № 146 -1- 10

I. EDUCATIONAL COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

1. Profile of the Philosophy Doctor program in the specialty "Computer Engineering"

1	2
1 – General information	
Full name of the higher education institution and structural division	**Lviv Polytechnic National University**
The full title of the qualification in the original language	**Philosophy Doctor degree in the specialty "Computer Engineering"**
The official name of the educational program	Computer Engineering
Type of diploma and scope of the educational program	Diploma of Philosophy Doctor, single, 43 ECTS credits educational component, the term of the educational component of the educational and scientific program 1,5 years
Cycle/level	NQF Level 8 (Third cycle of QF-EHEA / EQF Level 8)
Prerequisites	Level of higher education "Master"
Language(s) of instruction	Ukrainian
Basic concepts and their definitions	The educational and scientific program uses basic concepts and their definitions in accordance with the Law of Ukraine "On Higher Education" from 01.07.2014 р. № 1556-VII with changes and additions, Law of Ukraine "On scientific and scientific and technical activity" from 26.11.2015 р. № 848-VIII with changes and additions, The procedure for the preparation of higher education applicants for the degree of Doctor of Philosophy and Doctor of Science in higher educational institutions (scientific institutions), approved by the Resolution of the Cabinet of Ministers from 23.03.2016 р. № 261, Methodological recommendations for the development of higher education standards approved by the higher education sector of the Scientific and Methodological Council of the Ministry of Education and Science of Ukraine (protocol from 29.03.2016 р. № 3)
2 – The purpose of the educational and scientific program	
	To provide theoretical knowledge and practical abilities and skills for solving complex problems in the field of computer engineering, conducting scientific, research and innovation activities, as well as implementing the obtained results.
3 - Characteristics of the educational and scientific program	
Subject area (field of knowledge, specialty)	Fields of knowledge F Information technologies specialty F7 Computer engineering
Orientation of the educational program	The educational and scientific program is based on the fundamental principles of computer engineering and the results of modern scientific research in the field of building computer systems and networks. It is aimed at relevant aspects of the specialty, within the framework of which it deepens the professional scientific worldview and provides a basis for conducting scientific research and further professional and scientific activities.

1	2
The main focus of the educational program and specialization	Acquiring the necessary research skills for a scientific career, teaching special disciplines in the field of computer engineering and computer technologies, as well as commercialization of the results of research activities and technology transfer. **Keywords:** computer systems, computer networks, specialized computer systems, systems on a chip, networks on a chip, system software, cyber-physical systems, Internet of Things.
Features of the program	The educational and scientific program covers a wide range of modern innovative vectors of the development of the theory and practice of computer engineering, which forms an updated theoretical and applied basis for conducting scientific research.
4 – Eligibility of graduates of the educational program to employment and further education	

1	2
Suitability for employment	Jobs in scientific research institutes of the National Academy of Sciences of Ukraine, universities of the Ministry of Education and Science of Ukraine, scientific centers and high-tech IT companies and enterprises.
Further education	Scientific program of the fourth (scientific) level of higher education "Doctor of Sciences"

5 – Teaching and assessment

1	2
Teaching and learning	A combination of lectures and practical classes, a pedagogical workshop, consulting with a scientific supervisor and a scientific and pedagogical community with independent scientific and educational work.
Assessment	Written and oral exams, assessments, oral presentations.

6 – Programmatic competences

1	2
Integral competence (INT)	The ability to solve complex problems in the field of information technology, computer engineering and computer technology, to produce innovative scientific ideas, to master the methodology of scientific and pedagogical activity, to solve complex problems in the process of innovative research and professional activity, to conduct original scientific research in professional field at the international and national level.
General competences (GC)	1) Basic knowledge and understanding of the philosophical methodology of cognition, the key principles of professional ethics, the system of moral and cultural values. 2) The ability to initiate and conduct original scientific research, identify relevant scientific problems, search for and critically analyze information, produce innovative constructive ideas, and apply non-standard approaches to solving complex and atypical tasks. 3) The ability to demonstrate oratory and rhetorical skills when presenting the results of scientific research, to conduct a professional scientific conversation and debate with the wider scientific community and the public in Ukrainian, to form scientific texts in written form, to organize and conduct training sessions, to use progressive information and communication tools.

1	2
	4) The ability to present and discuss the results of scientific research in English orally and in writing, to read fluently and fully understand English-language scientific texts. 5) Ability to be purposeful and persistent, to self-improve throughout life, to be aware of social and moral responsibility for the obtained scientific results. 6) The ability to initiate, substantiate and manage actual scientific projects of an innovative nature, to independently conduct scientific research, to interact in a team and to show leadership skills in the implementation of scientific projects.
Special (professional) competences (SC)	1) Knowledge of modern development trends and the most important new scientific achievements in the field of information technologies, computer engineering and computer technologies. 2) Knowledge and understanding of modern scientific theories and methods, and the ability to effectively apply them for the analysis and synthesis of computer systems and networks of various purposes. 3) The ability to effectively apply methods of analysis, mathematical and simulation modeling, to perform real-life and model experiments when conducting scientific research. 4) The ability to integrate knowledge from other disciplines, apply a systematic approach and take into account non-technical aspects when solving engineering problems and conducting research. 5) The ability to develop and implement projects, including own research, which provide an opportunity to rethink existing or create new knowledge. 6) The ability to argue the choice of a method for solving a specialized problem, critically evaluate the obtained results and defend the decisions made.
7 – Program learning results
Knowledge (KN)	1) Ability to demonstrate knowledge of modern research methods in the field of computer engineering. 2) Ability to demonstrate in-depth knowledge in the chosen field of scientific research. 3) Ability to demonstrate an understanding of the impact of technical solutions in a public, economic and social context. 4) Ability to demonstrate knowledge and understanding of the philosophical methodology of scientific knowledge, psychological and pedagogical aspects of professional and scientific activity, own scientific outlook and moral and cultural values. 5) Ability to demonstrate sufficient knowledge of the English language, necessary for oral and written presentation of the results of scientific research, conducting professional scientific dialogue, full understanding of English-language scientific texts.
Skill (SK)	1) Search, analyze and critically evaluate information from various sources. 2) Apply knowledge and understanding to solve problems of synthesis and analysis of elements and systems, research and modeling of phenomena and processes characteristic of the chosen field of scientific research.

1	2
	3) Combine theory and practice, as well as make decisions and develop a strategy for solving scientific and applied problems, taking into account universal human values, public, state and industrial interests. 4) Work effectively both individually and as part of a team. 5) Independently perform experimental studies and apply research skills. 6) Argue the choice of methods for solving a scientific and applied problem, critically evaluate the obtained results and defend the decisions made.
Communication (COM)	1) Ability to communicate in business, scientific and professional language, use different speech styles, communication methods and techniques, demonstrate a wide scientific and professional vocabulary. 2) The ability to use modern information and communication tools and technologies to ensure effective scientific and professional communications.
Autonomy and responsibility (A&R)	1) Ability to adapt to new conditions, make decisions independently and initiate original research and innovation complex projects. 2) The ability to realize the need for lifelong learning in order to deepen the acquired and acquire new professional knowledge. 3) The ability to take a responsible approach to the work performed and achieve the set goal in compliance with the requirements of professional ethics.
8 – Resource support for program implementation	
Specific characteristics of personnel support	100% of the teaching staff involved in teaching professionally oriented disciplines have scientific degrees in their specialty
Specific characteristics of material and technical support	Use of modern equipment and software of leading IT companies, in particular IBM, Intel, NVidia, ARM, Microsoft, Xilinx, Cypress, Google, HP, Sun, Aldec Active-HDL, MATLAB, Simulink.
Specific characteristics of informational and methodological support	The use of the virtual learning environment of the Lviv Polytechnic National University and author's developments of the teaching staff.
9 – Academic mobility	
National credit mobility	On the basis of bilateral agreements between Lviv Polytechnic National University and technical universities of Ukraine.
International credit mobility	On the basis of bilateral agreements between Lviv Polytechnic National University and educational institutions of partner countries.
Education of foreign students of higher education	Possible.

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

№ і/о	Training cycles	The amount of study load of a graduate student (credits / %)		
		Mandatory components of the educational component	Elective components of the educational component	In total for the entire term teaching
1.	Cycle of disciplines that form general scientific competences and universal skills of the researcher	21/49	3/7	24/56
2.	Cycle of disciplines forming professional competences	10/23	6/14	16/37
3.	Cycle of subjects of free choice of a graduate student	-	3/7	3/7
	Total for the entire period of study	31/72	12/28	43/100

3. The structure of the educational component of the educational and scientific program

Code a/d	Components of the educational component	Number of credits	Form final control
1	2	3	4
1. Mandatory components of the educational component			
Cycle of disciplines that form general scientific competences and universal skills of the researcher			
MK1.1.	Philosophy and methodology of science	3	examination
MK1.2.	A foreign language for academic purposes, part 1	4	test
MK1.3.	A foreign language for academic purposes, part 2	4	examination
MK1.4.	Professional pedagogy	3	test
MK1.6.	Academic entrepreneurship	4	test
MK1.7.	Pedagogical practice	3	test
Total per cycle:		21	
Cycle of disciplines forming professional competences			
MK2.1.*	Analytical and numerical research methods	4	examination
MK2.2.*	Research seminar in the field of information technologies (discussion of publications, research in the field, novelties, discoveries, etc.)	3	test
MK2.3.	Research methods in computer engineering	3	test
Total per cycle:		10 (3+3+4)	
2. Selective components of the educational component			
Cycle of disciplines that form general scientific competences and universal skills of the researcher			
SC1.1	Business Foreign Language	3	test
SC1.2	Psychology of creativity and invention	3	test
SC1.3	Management of scientific projects	3	test
SC1.4	Technology of registration of grant applications and patent rights	3	test
SC1.5	Rhetoric	3	test
SC1.6	Modern inventions in research activities	3	test
SC1.7	Open scientific practices	3	test
SC1.8	Academic integrity and quality of education	3	test
SC1.9	Methodology of preparation of scientific publications	3	test
SC1.10	Quality of higher education (formation of internal quality assurance systems)	3	test
Total per cycle:		3	
*Cycle of disciplines forming professional competences ** *			
SC2.1	Cyber physical systems	3	examination
SC2.2	Quantum information and quantum computers	3	examination
SC2.3	Algebraic structures in information protection	3	examination
SC2.4	Modern nanotechnologies in electronics	3	examination
SC2.5	Internet of Things	3	examination
SC2.6	Design, analysis and synthesis of parallel algorithms	3	examination
SC2.7	Virtual measuring tools	3	examination
SC2.8	Artificial intelligence in cyber-physical systems	3	examination
SC2.9	Elaboration of the results of experimental studies	3	examination
SC2.10	Mathematical and computer modeling in scientific research	3	examination
Total per cycle:		6(3+3)	
3. Disciplines of the graduate student's free choice ** * *			
SC3.1	Discipline of the graduate student's free choice	3	test
Total per cycle:		3	
TOGETHER		43	

Note:

   * - the list of disciplines that form professional competences, the disciplines that are common to ESP of related fields and specialties are offered;

   ** - the list of optional disciplines forming professional competences must contain ten disciplines, from which the graduate student chooses two;

   *** - a graduate student can choose disciplines taught at Lviv Polytechnic National University or other domestic (foreign) higher education institutions (scientific institutions) at all levels.

4. Matrix of correspondence of program competencies to educational components

	INT	GC1	GC2	GC3	GC4	GC5	GC6	SC1	SC2	SC3	SC4	SC5	SC6
MK1.1.	•	•				•							
MK1.2.	•				•								
MK1.3.	•				•								
MK1.4.	•			•									
MK1.6.	•		•			•							
MK1.7.	•			•		•							
MK2.1.	•									•			•
MK2.2.	•							•	•		•		
MK2.3.	•							•	•			•	
SC1.1.					•								
SC1.2.		•											
SC1.3.							•						
SC1.4.				•									
SC1.5.				•									
SC1.6.							•						
SC1.7.						•							
SC1.8.		•											
SC1.9.				•									
SC1.10.						•							
SC2.1.	•							•	•				
SC2.2.	•							•	•				
SC2.3.	•							•	•				
SC2.4.	•							•	•				
SC2.5.	•							•	•				
SC2.6.	•								•			•	
SC2.7.	•											•	•
SC2.8.	•								•		•		
SC2.9.	•									•			•
SC2.10.	•									•			•

Legend: MKi – mandatory discipline, SCi – selective discipline, i – discipline number in the list of components of the educational component, INT – integral competence, GCj – general competence, SCj – special (professional) competence, j – competency number in the list of competencies of the educational component.

5. Matrix of providing program learning outcomes with the relevant components of the educational component

	KN1	KN2	KN3	KN4	KN5	SK1	SK2	SK3	SK4	SK5	SK6	COM1	COM2	A&R1	A&R2	A&R3
MK1.1.				•				•							•	
MK1.2.				•									•			
MK1.3.				•									•			
MK1.4.				•										•		•
MK1.6.		•						•						•		
MK1.7.		•							•					•		•
MK2.1.		•								•						
MK2.2.		•					•								•	
MK2.3.	•					•									•	
SC1.1.				•									•			
SC1.2.				•										•		
SC1.3.			•													
SC1.4.				•												
SC1.5.				•									•			
SC1.6.				•												
SC1.7.		•														
SC1.8.				•												•
SC1.9.				•												
SC1.10.				•												•
SC2.1.	•						•									
SC2.2.		•				•										
SC2.3.		•					•									
SC2.4.		•				•										
SC2.5.	•							•								
SC2.6.		•					•									
SC2.7.	•					•										
SC2.8.	•						•									
SC2.9.	•					•										
SC2.10.		•									•					

Legend: MKi – mandatory discipline, SCi – selective discipline, i – discipline number in the list of components of the educational component, KNm – program results (knowledge), SKm – program results (skills), COMm – program results (communication), A&Rm – program results (autonomy and responsibility), m – program result number in the list of program results of the educational component.

II. The scientific component of the educational and scientific program

The scientific component of the educational-scientific program involves the post-graduate student conducting his own scientific research under the guidance of one or two academic supervisors and the preparation of its results in the form of a dissertation.

The dissertation for obtaining the degree of Doctor of Philosophy is an independent detailed study that offers a solution to an actual scientific task in the specialty F7 "Computer engineering", the results of which are an original contribution to the sum of knowledge in the specialty F7 "Computer engineering" and are published in relevant publications.

The scientific component of the educational and scientific program is drawn up in the form of an individual plan of scientific work of a postgraduate student.

An integral part of the scientific component of the postgraduate educational and scientific program is the preparation and publication of scientific articles, speeches at scientific conferences, scientific professional seminars, round tables, and symposia.

The conduct of scientific research must be conducted in compliance with the norms of academic integrity - the use of only proven and reliable sources of information in research activities and conscientious reference to them; avoiding falsification or fabrication of information, scientific results with their further use in the dissertation work.

Topics of scientific research in specialty F7 Computer engineering:
1. Methods and means of building hardware of cyber-physical systems.
2. Methods and means of building software for cyber-physical systems.
3. Methods and means of creating computer systems on chip.
4. Methods and means of creating effective networks on chip.
5. Methods of organizing high-performance computing.
6. Methods and means of building Internet of Things hardware.
7. Methods and means of building Internet of Things software.
8. Methods and means of creating computer systems and networks.
9. Methods and means of building effective embedded computer systems.
10. Methods and means of building effective information protection structures.
11. Methods and means of creating computer systems on non-electronic base.
12. Construction methods and means of interaction of structural elements of computer systems.
13. Methods and means of designing special processors and supercomputers.

III. Certification of graduate students

Attestation of applicants for higher education with the degree of Doctor of Philosophy is carried out by a specialized academic council, formed for a one-time defense, on the basis of a public defense of scientific achievements in the form of a dissertation.

A mandatory condition for admission to the defense is the successful completion by the graduate student of his individual study plan, as well as the absence of signs of academic plagiarism in dissertation research prepared for defense, monographs, scientific articles in accordance with the Regulations for checking academic plagiarism of students' qualification papers, dissertation papers, materials, submitted for publication in periodical and non-periodical scientific publications of the Lviv Polytechnic.

Ensuring academic integrity at the University is based on the principles of the rule of law; democracy; legality; justice; tolerance; scientific integrity; professionalism; partnerships and mutual assistance; mutual respect and trust; openness and transparency; responsibility.

The volume of the main text of the dissertation should be 4.0 - 5.5 author's pages.