MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LVIV POLYTECHNIC NATIONAL UNIVERSITY

«APPROVED»
Rector of
Lviv polytechnic National university
_____ /Bobalo Yu/
«_____» _____ 2022

EDUCATIONAL AND PROFESSIONAL PROGRAM

Of the third level of high education

Specialty:124 *System analysis*

Branch of knowledge:12 *Information technologies*

Academic degree: Doctor of Philosophy,

Specialty: *System analysis*

Reviewed and approved
at the meeting of the Academic Council
of Lviv Polytechnic National University
«___» _____ 2022
Protocol # _____

Lviv 2022

Developed by the working group of scientific and methodological commission of specialty 124 "System analysis" of Lviv Polytechnic National University consisting of:

Chair of working group (guarantor):	
Pasichnyk V.	– doctor of science, professor, full professor, ISN dept
Members:	
Berko A.	– doctor of science, professor, full professor, ISN dept
Lytvyn V.	– doctor of science, professor, full professor, chair of ISN dept
Veres O.	– Ph.D., docent, docent, ISN dept

Garantor _____ doctor of science, professor Pasitchyk V.

Approved and enacted by the Order of the Rector of Lviv Polytechnic National University from «____» _____ 2022# ___.

I. EDUCATIONAL COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

1. Ph.D. Program Profile
specialty 124 "System analysis"

1 – general information	
1	2
Full name of the higher education institution and structural unit	**Lviv Polytechnic National University**
Level of higher education	Third level
Higher Education Degree	Doctor of Philosophy
Branch of knowledge	12 Information technologies
Specialty	124 System analysis
Restrictions on forms of education	Full-time and part-time forms of education
Educational qualifications	**Doctor of Philosophy in System Analysis**
Full name of qualification	**Doctor of Philosophy in Systems Analysis**
The official name of the educational program	System analysis
Qualification in diploma	Higher Education Degree – Doctor of Philosophy Specialty – 124 System analysis
Type of diploma and scope of educational program	Diploma of Doctor of Philosophy, single, 43 ECTS credits of the educational component of the educational and scientific program, the term of the educational component of the educational and scientific program is 2 years
Cycle/level	LDC of Ukraine – level 8, FQ-EHEA – third cycle, EQF-LLL – level 8
Prerequisites	Availability of a master's level
Language(s) of instruction	Ukrainian
Basic concepts and their definitions	The educational and scientific program uses the basic concepts and their definitions in accordance with the Law of Ukraine "On Higher Education" of 01.07.2014, No 1556-VII with amendments and additions, the Law of Ukraine "On scientific and scientific-technical activity" of 26.11.2015, No 848-VIII with amendments and additions, the Procedure for training higher education applicants for the degree of Doctor of Philosophy and Doctor of Sciences in higher educational institutions (research institutions), approved by the Resolution of the Cabinet of Ministers of 23.03.2016 No 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 of 29.03.2016, No 3)
Domain description	*Object*: mathematical methods and information technologies of analysis, modeling, forecasting, design and decision-making regarding complex systems of various nature (information, economic, financial, social, technical, organizational, environmental, etc.). *The purpose of training*: training specialists who are able to develop and apply methods and means of system analysis to solve complex problems in various fields of activity.

	Theoretical content of the subject area: control theory and decision making, mathematical and computer modeling, mathematical statistics, data analysis, operations research, optimization of systems and processes. *Methods, methods and technologies*: methods of mathematical modeling, data analysis, optimization and research of operations, forecasting, risk assessment, management theory and decision-making, theory of games and conflicts, expert assessment, sustainable development *Tools and equipment*: specialized software
Academic rights of graduates	Eligibility for the next academic degree
2 – The purpose of the educational program	
	To deepen theoretical knowledge and practical skills in the field of information technology in the specialty of system analysis, to develop philosophical and linguistic competencies, to form universal skills of the researcher, sufficient for the conduct and successful completion of scientific research and further professional and scientific activities
3 - Characteristics of the educational program	
Orientation of the educational program	The educational and scientific program is based on the fundamental postulates of system analysis and the results of modern scientific research in the field of innovative development of the theory and practice of system analysis. It is aimed at the actual aspects of the specialty, within which further scientific and teaching career is possible.
Features and differences	The scientific component of the educational and scientific program is determined by the individual curriculum of the PhD student
4 – Eligibility for Education Program Graduates to employment and further education	
Eligibility for employment	Jobs in public and private higher educational institutions, scientific and research institutions as teachers and researchers, in enterprises and organizations of various types of activities and forms of ownership in managerial positions.
Further education	Scientific program of the fourth (scientific) level of higher education "Doctor of Science"
5 – Teaching and assessment	
Teaching & Learning	Combination of lectures and practical classes, research laboratory works, pedagogical workshop, consultation with the supervisor, scientific and pedagogical community with independent scientific and educational work
Evaluation	Examinations, current control, laboratory reports, essays, presentations.
6 – Програмні компетентності	
Integral competence (INT)	Ability to solve complex problems in the field of professional and / or research and innovation activities in the field of system analysis, which involves a deep rethinking of existing and the creation of new holistic knowledge and / or professional practice.
General competencies (ЗК)	ЗК 01. Ability to abstract thinking, analysis and synthesis. ЗК 02. Ability to search, process and analyze information from various sources. ЗК03. Ability to develop and manage projects.
Special (professional)	СК01. Ability to perform original research, achieve scientific results

Competences (CK)	that create new knowledge in system analysis and related interdisciplinary areas and can be published in leading scientific journals on information technology and related fields. CK02. Ability to orally and in writing present and discuss the results of scientific research and / or innovative developments in Ukrainian and English, deep understanding of English-language scientific texts in the field of research. CK03. Ability to apply modern information technologies, databases and other electronic resources, specialized software in scientific and educational activities. CK04. Ability to initiate, develop and implement complex innovative projects in data analysis to support decision making and related interdisciplinary projects, leadership during their implementation. CK05. Ability to analyze and synthesize complex systems of various nature (economic, financial, social, political, technical, organizational, environmental, etc.). CK06. Ability to solve scientific or applied problems that arise in complex systems. CK07. Mastering general scientific (philosophical) competencies aimed at forming a systemic scientific worldview, professional ethics and general cultural outlook; application of modern information technologies in scientific activities (work with NMBD, automatic formation of links to literary sources). CK08. Acquisition of universal skills of the researcher, in particular, organizing and conducting training sessions, application of modern information technologies (work with VNS, Microsoft Teams, ZOOM, etc.). CK09. Acquisition of universal skills of a researcher, in particular oral and written presentation of the results of his/her own scientific research in Ukrainian, management of scientific projects and/or drawing up proposals for research funding, registration of intellectual property rights, application of modern information technologies. CK10. Acquisition of in-depth knowledge in the specialty in which the graduate student conducts research, in particular mastering basic concepts, understanding theoretical and practical problems, history of development and the current state of scientific knowledge in the chosen specialty, mastering terminology in the studied scientific direction in the amount of ECTS credits in accordance with the standard of higher education.
7 – Programmatic learning outcomes	
Knowledge (PH)	PH01. Have advanced conceptual and methodological knowledge of system analysis and at the interface of subject areas, as well as research skills sufficient to conduct scientific and applied research at the level of the latest world achievements in the relevant field, gain new knowledge and / or innovate. PH02. Formulate and test hypotheses; use appropriate evidence to substantiate the conclusions, in particular, the results of theoretical analysis, experimental studies (surveys, observations) and mathematical and / or computer modeling, available literature data. PH03. Develop and explore conceptual, mathematical, informational and computer models of processes and systems, effectively use them to obtain new knowledge and/or create innovative products in data analytics and related interdisciplinary areas.

	PH04. Apply modern tools and technologies for searching, processing and analyzing information, in particular, statistical methods for analyzing data of large volume and / or complex structure, specialized databases and information systems. PH05. Be able to develop and implement scientific projects on the methodology and technologies of system analysis. PH06. Deeply understand the general principles and methods of system analysis, apply them in their own research and in teaching practice. PH07. Apply knowledge and understanding to solve problems of synthesis and analysis of elements and systems characteristic of the chosen field of scientific research. PH08. Investigate and model phenomena and processes in complex dynamic information systems. PH09. Ability to work effectively both individually and as part of a team. PH10. Ability to independently perform experimental research and apply research skills, develop cognitive systems in poorly structured data of various nature. PH11. Ability to analyze and define criteria within the subject area, build models of multicriteria problems and be able to solve them, evaluate complex systems and multicriteria analysis of processes that arise in a given problem area. PH12. The ability to build mathematical models and methods of natural language processing, using the methods and means of cognitive, communicative, computational, statistical and quantitative linguistics to solve problems that arise in a given problem area.
Communication (KOM)	1) Ability to communicate, apply different styles of speech, methods and techniques of communication, demonstrate a wide scientific and professional terminological vocabulary. 2) Ability to use a variety of tools, including modern information technology, to communicate effectively at professional and social levels.
Autonomy and responsibility (AiB)	1) Ability to adapt to new situations and make appropriate decisions. 2) Ability to realize the need for lifelong learning in order to deepen acquired and acquire new professional knowledge. 3) The ability to responsibly treat the work performed, make decisions independently, achieve the goal in compliance with the requirements of professional ethics.
8 – Resource support for program implementation	
Specific characteristics of staffing	100% of scientific and pedagogical workers involved in teaching a cycle of disciplines that provide special (professional) competencies of a graduate student, have scientific degrees and academic titles, are recognized professionals with experience in research, management or innovation work in the specialty
Specific characteristics of the supply of materials and means	Use of modern computer tools and software.
Specific characteristics of information and	Use of the virtual learning environment of Lviv Polytechnic National University and author's developments of scientific and pedagogical

methodological support	workers, namely: textbooks and manuals with the stamp of the Ministry of Education and Science of Ukraine series "Informatics", "Computing" and "Consolidated Information"; textbooks and manuals approved by Academic Council of Lviv Polytechnic National University.
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 higher educational institutions of foreign partner countries
Training of foreign applicants for higher education	Is possible

2. The distribution of content of educational and professional program by component groups and education cycles

#	Education cycles	The amount of postgraduate student workload (credits / %)		
		Mandatory components	Selective components	Total for the entire period of study
1.	A cycle of disciplines that form general scientific competencies and universal skills of a researcher	21/49	3/7	24/56
2.	Cycle of disciplines that form professional competencies	10/23	6/14	16/37
3.	Cycle of disciplines of free choice of student	-	3/7	3/7
Total for the entire period of study		31/72	12/28	43/100

3. List of components of the educational and professional program

Code	Component Name	The size of the component in ECTS credits	Summary control form
1	2	3	5
REQUIRED COMPONENTS			
I. General study cycle *A cycle of disciplines that form general scientific competencies and universal skills of a researcher*			
ОК1.1.	Philosophy and methodology of science	3	exam
ОК1.2.	Foreign Language for Academic Purposes, part 1	4	diff. test
ОК1.3.	Foreign Language for Academic Purposes, part 2	4	exam
ОК1.4.	Professional pedagogy	3	diff. test
ОК1.5.	Academic entrepreneurship	4	diff. test
ОК1.6.	Pedagogical practice	3	diff. test
	Total cycle:	**21**	
II. Cycle of professional study *Cycle of disciplines that form professional competencies*			
ОК2.1.	Methods of analysis and optimization of complex systems	4	exam
ОК2.2.	Research seminar on specialty 124 System analysis	3	diff. test
ОК2.3.	Modeling, analysis and synthesis of interaction of complex information systems	3	diff. test
	Total cycle:	**10**	
	Total required components of the specialty:	**31**	
SELECTIVE COMPONENTS OF THE EDUCATIONAL AND PROFESSIONAL PROGRAM			
I. General study cycle *A cycle of disciplines that form general scientific competencies and universal skills of a researcher*			
ВБ1.1	Business English	3	diff. test
ВБ1.2	Psychology of creativity and invention	3	diff. test
ВБ1.3	Scientific Project Management	3	diff. test
ВБ1.4	Technology of registration of grant applications and patent rights	3	diff. test
ВБ1.5	Rhetoric	3	diff. test
ВБ1.6	Modern invention in research activities	3	diff. test
ВБ1.7	Open scientific practices	3	diff. test
ВБ1.8	Academic integrity and quality of education	3	diff. test
ВБ1.9	Methodology for preparing scientific publications	3	diff. test
ВБ1.10	Quality of higher education (formation of internal quality assurance systems)	3	diff. test
	Total cycle:	**3**	

Table continuation

1	2	3	5
II. Cycle of professional study			
Cycle of disciplines that form professional competencies			
ВБ2.1	Intelligent decision support systems	3	exam
ВБ2.2	Methods of multivariate analysis	3	exam
ВБ2.3	Project and program management methodology	3	exam
ВБ2.4	Electronic science and knowledge management in socio-communication projects and programs	3	exam
ВБ2.5	Computer recognition and classification technologies in complex systems	3	exam
ВБ2.6	Mathematical linguistics	3	exam
ВБ2.7	Multicriteria analysis of systems and processes of different nature	3	exam
ВБ2.8	Pattern recognition in situational awareness systems	3	exam
ВБ2.9	IT project, portfolio and program management technologies	3	exam
ВБ2.10	Modeling, analysis and synthesis of interaction of complex information systems under uncertainty	3	exam
	Total cycle:	**6 (3+3)**	
Discipline of free choice of graduate student			
ВБ3.1	Discipline of free choice of graduate student	3	diff. test
	Total cycle:	**3**	
	Total selective components	**12**	
	Total for the educational and professional program:	**43**	

4. Matrix of correspondence of program competencies to the educational components of educational and scientific program of Doctor of Philosophy in the specialty "System Analysis"

Code	Competencies													
	Integral	General competencies			Special (professional) competencies									
	ІНТ	ЗК1	ЗК2	ЗК3	СК01	СК02	СК03	СК04	СК05	СК06	СК07	СК08	СК09	СК10
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ОК1.1	•	•	•		•	•	•	•	•	•	•			
ОК1.2	•					•								
ОК1.3	•					•								
ОК1.4	•											•		
ОК1.5	•												•	
ОК1.6	•	•			•	•			•	•		•		
ОК2.1	•	•	•		•	•	•	•	•	•				•
ОК2.2	•	•	•		•	•	•							•
ОК2.3	•	•	•	•	•	•	•	•	•	•				•

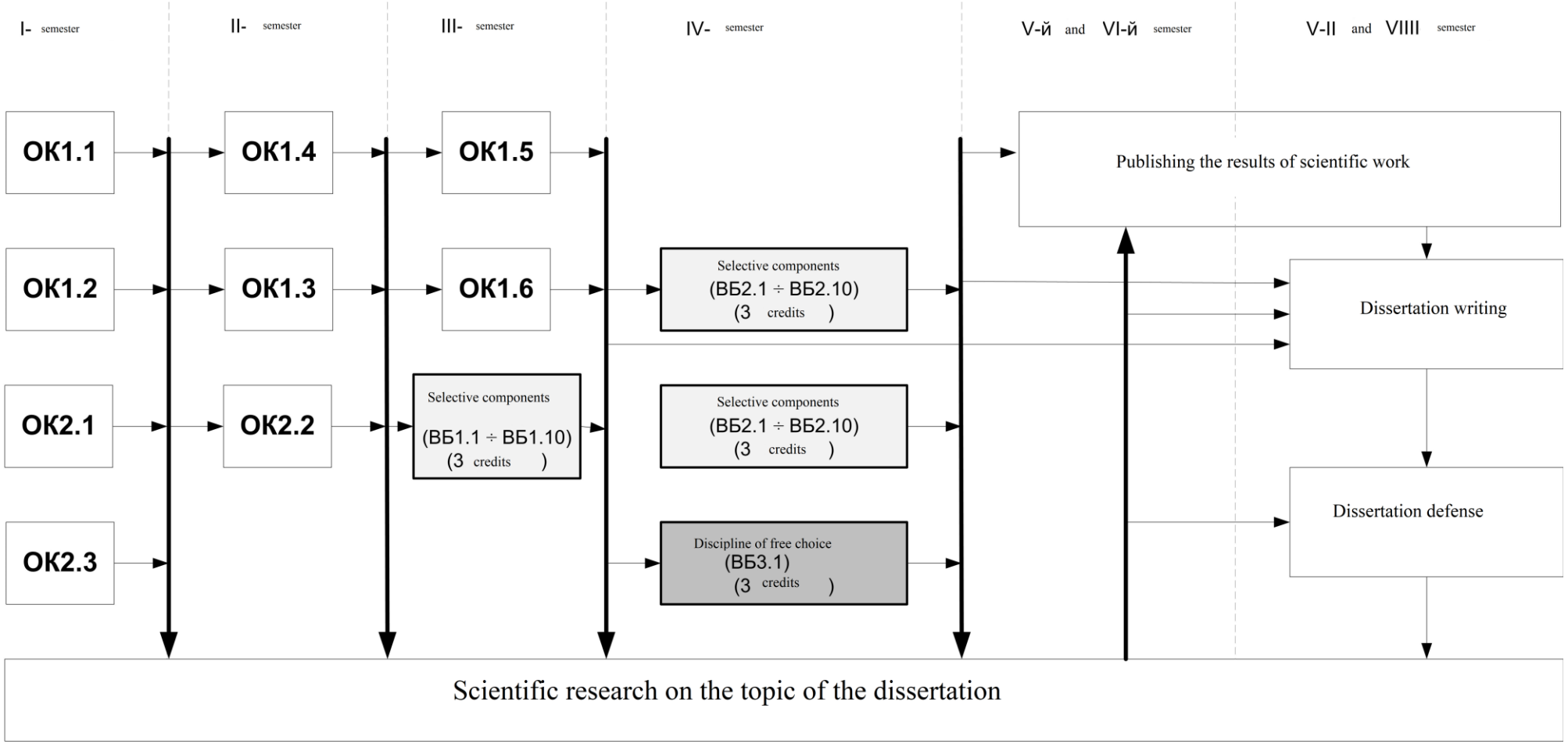
Legend: OK1.i – required discipline of the general training cycle, OK2.i – required discipline of the vocational training cycle, I – number of the discipline in the list of components of the educational component, INT – integral competence, CKj – competence, j – competence number in the list of competencies of the educational component.

5. Matrix of providing program learning outcomes with relevant components of the educational component educational and professional program of Doctor of Philosophy in the specialty "System Analysis"

Learning outcomes	Required components of the educational component of the specialty								
	ОК1.1	ОК1.2	ОК1.3	ОК1.4	ОК1.5	ОК1.6	ОК2.1	ОК2.2	ОК2.3
РН01	•						•		
РН02							•	•	•
РН03									•
РН04							•	•	•
РН05							•	•	
РН06						•	•	•	•
РН07									•
РН08							•		•
РН09	•	•	•	•	•	•		•	
РН10				•				•	
РН11									•
РН12							•		
КОМ1	•	•	•	•	•	•	•	•	•
КОМ2	•	•	•	•	•	•	•	•	•
АіВ1	•				•	•	•	•	•
АіВ2	•	•	•	•	•	•	•	•	•
АіВ3	•				•	•	•	•	•

Legend: OK1.i – required discipline of the general training cycle, OK2.i – required discipline of the professional training cycle, I – number of the discipline in the list of components of the educational component, PHm – program results (knowledge), KOMm – program results (communication), AiBm – program results (autonomy and responsibility), m – number of the program result in the list of program results of the educational component.

6. Structural and logical scheme of the educational and scientific program of the third (educational and scientific) level of higher education
specialty 124 "System analysis"



II. The scientific component of the educational and scientific program

The scientific component of the educational and scientific program involves conducting a postgraduate student's own scientific research under the guidance of one or two supervisors and summarizing its results in the form of a dissertation.

The dissertation for the degree of Doctor of Philosophy is an independent detailed research that offers the solution of an actual scientific problem in the specialty 124 "System Analysis", the results of which are characterized by scientific novelty and practical value and 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 the PhD student and is an integral part of the postgraduate curriculum.

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

Topics of scientific research in specialty 124 "System analysis":

1. Development of methods for analyzing and optimizing complex interrelated systems of different nature.
2. Design of complex systems operating under uncertainty.
3. Development of decision theory in management, forecasting and optimization in complex systems.
4. System analysis of multicriteria processes of different nature.
5. Modeling, analysis and synthesis of interaction of complex controlled systems, including game, stochastic, minimax, fuzzy sets of models.
6. Creation of problem-oriented technologies of expert systems.
7. Optimization and control of dynamic systems under control and phase state constraints.
8. Creation of computer technologies for recognition and classification in complex systems.
9. Development of certified software products for object-oriented implementation using system analysis methods and optimal solutions.
10. Development of project and program management methodology.
11. Development of project and program management processes.
12. Development of knowledge management methods in projects and programs.
13. Development of the theory and methodologies of structural, applied and mathematical linguistics.
14. The development of set-theoretic models in linguistics.
15. Development of linguistic informatics, cybernetics, synergetics, semiotics and sign systems of language.

16. Computer-linguistic methods and means of analyzing the information image of geospatial objects in social and communication systems.
17. Methods and means of computer-linguistic analysis of complex social processes on the Internet.
18. Methods and tools for analyzing the correctness of the information content of the organization's web community.
19. Methods and means of increasing the efficiency of analysis of complex social processes on the Internet.
20. Mathematical and software for information modeling of problem areas using databases.

III. Certification of PhD students

Forms of certification of applicants for higher education	Certification of applicants for the educational level of Doctor of Philosophy is carried out in the form of public defense of the dissertation. A prerequisite for admission to defense is the successful completion by the graduate student of his individual curriculum.
Requirements for qualification work	The dissertation is an independent detailed research that offers the solution of an actual scientific problem in the field of system analysis, the results of which constitute an original contribution to the sum of knowledge in this field and are published in relevant publications. Requirements for the design of dissertations are established by separate provisions. The dissertation work should not contain academic plagiarism, falsification, fabrication. The dissertation work and its abstract should be posted on the website of the higher education institution (research institution). The dissertation work must meet other requirements established by law.
Requirements for public defense (demonstration) (if available)	Requirements regarding the procedure and special conditions for public defense are determined by separate provisions

IV. Requirements for the internal quality assurance system of higher education

Lviv Polytechnic National University has a system of ensuring the quality of educational activity and quality of higher education by a higher educational institution (internal quality assurance system), which provides for the implementation of such procedures and measures:

- definition of principles and procedures for quality assurance in higher education;
- monitoring and periodic review of educational programs;
- annual evaluation of higher education students, scientific-pedagogical and pedagogical staff of the higher educational institution and regular publication of the results of such assessments on the official website of the higher educational institution, on information stands and in any other way;
- ensuring advanced training of pedagogical, scientific and scientific-pedagogical workers;
- ensuring the availability of necessary resources for the organization of the educational process, including independent work of students, for each educational program;
- ensuring the availability of information systems for effective management of the educational process;
- ensuring the publicity of information about educational programs, higher education degrees and qualifications;
- ensuring an effective system for preventing and detecting academic plagiarism in the scientific works of employees of higher educational institutions and applicants for higher education;
- other procedures and measures.

The system of ensuring the quality of educational activity and quality of higher education by a higher educational institution (internal quality assurance system) upon submission of the higher education institution is assessed by the National Agency for Higher Education Quality Assurance or independent institutions for higher education quality assessment and assurance accredited by it for its compliance with the requirements for the higher education quality assurance system approved by the National Agency for Higher Education Quality Assurance, and international standards and recommendations for quality assurance in higher education.