

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LVIV POLYTECHNIC NATIONAL UNIVERSITY**

«APPROVED»

Rector
of Lviv Polytechnic
National University

_____ Yurii Bobalo

« ____ » _____ 2022

**EDUCATIONAL-SCIENTIFIC PROGRAMME
«AUTOMATION AND COMPUTER-INTEGRATED TECHNOLOGIES»**

**THIRD (EDUCATIONAL-SCIENTIFIC) LEVEL OF HIGHER
EDUCATION**

FIELD OF STUDY	<u>15 Automation and Instrumentation</u>
PROGRAMME	
SUBJECT AREA	<u>151 Automation and Computer-Integrated Technologies</u>
QUALIFICATION	<u>Doctor of Philosophy on Automation and Computer-Integrated Technologies</u>

Discussed and approved
at the meeting of the Academic Council
of Lviv Polytechnic
National University
Minutes No. _____
of _____ 2022

**LETTER OF AGREEMENT
of educational-scientific programme**

Level of higher education	Third (educational-scientific)
FIELD OF STUDY	15 Automation and Instrumentation
PROGRAMME SUBJECT AREA	151 Automation and Computer-Integrated Technologies
Specialization	-
Qualification	Doctor of Philosophy on Automation and Computer-Integrated Technologies

DEVELOPED AND APPROVED

Scientific and methodical commission (SMC) of the programme subject area 151 Automation and Computer-Integrated Technologies

Minutes No. _____
of _____ 2022

Head of the SMC of the programme subject area

_____ Fedir Matiko

CONFIRMED

Vice-Rector for Graduate Education of Lviv Polytechnic National University

_____ Oleh Davydchak

_____ 2022

Head of Educational and Methodical Department of University

_____ Valeriy Sviridov
_____ 2022

RECOMMENDED

Scientific and methodical council (SMC) of University

Minutes No. _____
of _____ 2022

Head of the SMC of University
_____ Anatolii Zahorodnii

Director of Institute of Power Engineering and Control Systems

_____ Andrii Lozynskyi
_____ 2022

PREFACE

Developed by the work group of the scientific and methodical commission of the programme subject area 151 "Automation and Computer-Integrated Technologies". The work group members:

- | | |
|----------------------|---|
| Fedir Matiko | – Sc.D., Prof., Head of Department of Automation and Computer-Integrated Technologies; |
| Yevhen Pistun | – Sc.D., Prof., Professor of Department of Automation and Computer-Integrated Technologies; |
| Andrii Kutsyk | – Sc.D., Prof., Professor of Department of Electromechanics and Computerized Electromechanical Systems; |
| Vasyl Fedynets | – Sc.D., Assoc.Prof., Professor of Department of Automation and Computer-Integrated Technologies; |
| Roman Fedoryshyn | – Sc.D., Assoc.Prof., Assoc.Prof. of Department of Automation and Computer-Integrated Technologies; |
| Olga Khymko | – Sc.D., Assoc.Prof., Assoc.Prof. of Department of Automation and Computer-Integrated Technologies; |
| Viktoriia Sorokun | – Ph.D. student (1-st year of study), programme subject area 151 "Automation and Computer-Integrated Technologies"; |
| Anastasiia Vakarchuk | – Head of Students and Ph.D. Students Union of Lviv Polytechnic National University |
| Serhii Kril | – Ph.D., Director of the automation and industrial programming department of "Robitnia" LLC |

Guarantor of the educational programme

(signature)

Fedir Matiko

The project of the educational-scientific programme was discussed and approved at the meeting of the Academic Council of the Educational and Scientific Institute of Power Engineering and Control Systems (IPECS)

Minutes No. ____ of _____ 2022

Head of the Academic Council of IPECS _____
(signature)

Andrii Lozynskyi
(прізвище, ініціали)

Approved and brought into force

by the Order of Rector of Lviv Polytechnic National University

No. _____ of _____ 2022

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I. EDUCATIONAL COMPONENT OF THE EDUCATIONAL-SCIENTIFIC PROGRAMME

1. Profile of the programme for Doctor of Philosophy in the subject area 151 "Automation and Computer-Integrated Technologies"

1 – General information	
Full name of higher education institution	Lviv Polytechnic National University
Level of higher education	Third (educational-scientific)
Degree	Doctor of Philosophy
Field of Study	15 – Automation and Instrumentation
Programme Subject Area	151 – Automation and Computer-Integrated Technologies
The name of the educational-scientific programme	Automation and Computer-Integrated Technologies
Mode of study	Full-time (day, evening), part-time
Educational qualification	Doctor of Philosophy in Automation and Computer-Integrated Technologies
Qualification in diploma	Degree: Doctor of Philosophy Field of Study: 15 – Automation and Instrumentation Programme Subject Area: 151 – Automation and Computer-Integrated Technologies Specialization: (optional) The name of the educational-scientific programme: Automation and Computer-Integrated Technologies
Scope of the educational program	43 ECTS credits, duration of the educational component of the educational-scientific programme is 1.5 years
Access requirements	Master's Degree
Language(s) of study	Ukrainian
Describing of subject area	<p><i>Object of activity:</i> objects and processes of automated control (technological processes, production, organizational structures), technical, informational, mathematical, software and organizational support of automation systems and robotic systems in various fields.</p> <p><i>Learning objectives:</i> acquiring the ability to solve complex problems of professional and/or research and innovation activities in the field of automation and computer-integrated technologies, which involves a deep reinterpretation of the existing and creation of new integral knowledge and/or professional practice.</p> <p><i>Theoretical content of the subject area:</i> concepts, principles, theories of automatic control, development of automation systems and computer-integrated technologies.</p> <p><i>Methods, techniques and technologies:</i> modern methods of theoretical and experimental research, synthesis, design, debugging of automation systems and computer-integrated technologies.</p>

	<i>Tools and equipment:</i> microprocessor tools, Internet of Things components, intelligent mechatronic components, specialized software and technical tools for designing, developing and operating automation systems and robotic systems.
2 – Eligibility of graduates of the educational program to employment and further education	
Eligibility to employment	Areas of activity covering the creation, design, adjustment of computer-integrated technologies, automation systems in various fields of activity, conducting scientific research and pedagogical activity in education. Positions of scientific and scientific-pedagogical employees in scientific institutions and institutions of higher education, engineering positions in research, project and design institutions and divisions of enterprises.
Further education	Obtaining a Doctor of Science degree, as well as additional qualifications in the adult education system.
3 – Teaching and assessment	
Teaching and learning	Lectures, laboratory work, practical classes, individual work on the implementation of projects, consultations with teachers, pedagogical practice, completion of a doctoral dissertation.
Assessment	Written and oral exams, assessments, laboratory reports, spoken presentations, ongoing control, individual research tasks.
4 – Program competencies	
Integral competence (IC)	The ability to produce new ideas, to solve complex problems of professional and/or research and innovation activities in the field of automation and computer-integrated technologies, to apply the methodology of scientific and pedagogical activity, as well as to conduct own scientific research, the results of which have scientific novelty, theoretical and practical significance.
General competences	GC1. Ability to generate new ideas (creativity). GC2. Ability to search, process and analyze information from various sources. GC3. Ability to work in an international context. GC4. The ability to solve complex problems in the field of automation and computer-integrated technologies and from tangential to interdisciplinary directions based on a systemic scientific worldview and a general cultural outlook in compliance with the principles of professional ethics and academic integrity.
Specific (professional, subject) competences	SC1. The ability to perform original research, achieve scientific results that create new knowledge in the field of automation, computer-integrated technologies, management of complex organizational-technical or cyber-physical systems and related interdisciplinary areas and can be published in leading scientific publications. SC2. The ability to orally and in writing present and discuss the results of scientific research and/or innovative developments in Ukrainian and foreign languages, a deep understanding of foreign language scientific texts in the direction of research. SC3. Ability to apply modern methods of research, synthesis, design of automation systems, computer-integrated technologies, their software and hardware components, specialized software in scientific and teaching activities.

	<p>SC4. The ability to initiate, develop and implement complex innovative projects in the field of automation and computer-integrated technologies and interdisciplinary projects in related fields, to show leadership during their implementation.</p> <p>SC5. The ability to create the latest automation systems, computer-integrated technologies, develop their technical, informational, mathematical, software and organizational support using modern information technologies, tools and components.</p> <p>SC6. The ability to carry out scientific and pedagogical activities in higher education</p>
5 – Program learning outcomes	
	<p>LO1. Have advanced conceptual and methodological knowledge of automation and computer-integrated technologies and related interdisciplinary areas, understand the methodology of scientific research. To be able to apply them in one's own research, aimed at obtaining new knowledge and/or implementing innovations, and in teaching practice.</p> <p>LO2. Freely present and discuss with specialists and non-specialists the results of research, scientific and applied problems of automation and computer-integrated technologies in national and foreign languages, publish the results of research in scientific publications in leading scientific publications.</p> <p>LO3. Develop and research conceptual, mathematical and computer models of automation objects and processes, effectively use them to obtain new knowledge and/or create innovative developments in the field of automation and computer-integrated technologies and related interdisciplinary areas.</p> <p>LO4. Plan and perform experimental and/or theoretical research of automation systems, computer-integrated complexes and their components using modern research methods, technical and software tools and in compliance with the norms of academic and professional ethics. Formulate and test hypotheses; use the results of theoretical analysis, experimental research and mathematical and/or computer modeling, available literature data to substantiate the conclusions.</p> <p>LO5. Develop and implement scientific and/or innovative engineering projects in the field of automation and computer-integrated technologies, which make it possible to reinterpretation existing and create new integral knowledge and/or professional practice, considering economic, legal, social and environmental aspects. To ensure the protection of intellectual property.</p> <p>LO6. Develop and apply modern methods of analysis, synthesis, design and research of automation systems, computer-integrated technologies, their software and hardware components.</p> <p>LO7. Apply modern digital technologies, microprocessors, mechatronic components, specialized software to create the latest automation systems, computer-integrated technologies, their technical, informational, mathematical, software and organizational support.</p> <p>LO8. Apply modern tools and technologies for searching, processing and analyzing information, in particular, statistical methods of data analysis, specialized databases and information</p>

	<p>systems.</p> <p>LO9. To organize and carry out the educational process in the field of automation and computer-integrated technologies, its scientific, educational and methodological support, to develop and teach special educational disciplines in institutions of higher education.</p>
Communication (COM)	COM1. Ability to use a variety of methods, including modern information technology, for effective communication at professional and social levels.
Autonomy and responsibility (A&R)	<p>A&R1. Ability to adapt to new conditions and make decisions independently;</p> <p>A&R2. The ability to realize the need for lifelong learning to deepen the acquired and acquire new professional knowledge;</p> <p>A&R3. The ability to take a responsible attitude to the work performed and achieve the set goal in compliance with the requirements of professional ethics.</p>
6– Resource support for program implementation	
Specific characteristics of personnel support	100% of scientific and pedagogical workers involved in teaching professionally oriented disciplines have scientific degrees and scientific titles.
Specific characteristics of material and technical support	<p>Use of modern equipment from leading manufacturers of automation tools and systems, including Siemens, Schneider Electric, Unitronics, Mikrol, Wonderware InTouch.</p> <p>Use of modern computer tools and software.</p>
The main specific characteristics of informational and methodological support	The use of the virtual learning environment of the National University "Lviv Polytechnic" and author's developments of research and teaching staff.
7 – Academic mobility	
National credit mobility	Based on bilateral agreements between Lviv Polytechnic National University and technical universities of Ukraine.
International credit mobility	Based on bilateral agreements between Lviv Polytechnic National University and technical universities of Ukraine.
Education of foreign students	Possible.

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

№ п/п	Training cycles	The scope of the educational load of the graduates (credits / %)		
		Mandatory components of the educational and scientific program	Elective components of the educational and scientific program	Total for the entire period of study
1	2	3	4	5
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 graduates	-	3 / 7	3 / 7
Total for the entire period of study		31 / 72	12 / 28	43 / 100

3. List of components of the educational component of the educational and scientific program

Code	The name of the component of the educational component	The volume of the component in ECTS credits	Final control form
1	2	3	4
1. Mandatory components of the educational component			
<i>1.1. Cycle of disciplines that form general scientific competences and universal skills of the researcher</i>			
OK1.1.	Philosophy and Methodology of Science	3	exam
OK1.2.	English Language For Academic Purposes, part 1	4	test
OK1.3.	English Language For Academic Purposes, part 2	4	exam
OK1.4.	Professional Pedagogy	3	test
OK1.5.	Academic Entrepreneurship	4	test
OK1.6.	Pedagogical Workshops	3	test
Total per cycle:		21	
<i>1.2. Cycle of disciplines forming professional competences</i>			
OK2.1.	Analytical and Numerical Methods of Research	4	exam
OK2.2.	Research seminar in the field of automation and instrumentation	3	test
OK2.3.	Current Research Methods of Technological Objects and Curatorial Influences Formation	3	test
Total per cycle:		10	

2. Selective components of the educational component			
<i>2.1. Components forming general scientific competences and universal skills of the researcher</i>			
BB1.1	Business Foreign Language	3	test
BB1.2	Psychology of creativity and invention	3	test
BB1.3	Management of scientific projects	3	test
BB1.4	Technology of registration of grant applications and patent rights	3	test
BB1.5	Rhetoric	3	test
BB1.6	Quality of higher education (formation of internal quality assurance systems)	3	test
BB1.7	Open scientific practices	3	test
BB1.8	Academic integrity and quality of education	3	test
BB1.9	Modern inventory in research activities	3	test
BB1.10	Methodology of preparation of scientific publications	3	test
Total per cycle:		3	
<i>2.2. Components forming professional competences</i>			
BB2.1	Application of optimization methods in automation tasks	3	exam
BB2.2	Probabilistic methods in automation tasks	3	exam
BB2.3	Automated systems for measuring parameters of fluid environments	3	exam
BB2.4	Modern methods of digital signal processing	3	exam
BB2.5	Design automation of computer-integrated technologies	3	exam
BB2.6	Automated design systems of technical means of automation	3	exam
BB2.7	Modern control methods and their application in electrical engineering systems	3	exam
BB2.8	System analysis and identification methods of electrical engineering objects	3	exam
Total per cycle:		6	
3. Disciplines of the graduate's free choice*			
BB3.1	Disciplines of the graduate's free choice	3	test
Total per cycle:		3	
TOTAL		43	

Note: * - 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. Correspondence matrix of program competencies to the components of the educational program

	OC1.1	OC1.2	OC1.3	OC1.4	OC1.5	OC1.6	OC2.1	OC2.2	OC2.3	OB1.1	OB1.2	OB1.3	OB1.4	OB1.5	OB1.6	OB1.7	OB1.8	OB1.9	OB1.10	OB2.1	OB2.2	OB2.3	OB2.4	OB2.5	OB2.6	OB2.7	OB2.8	OB3.1	
IC	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
GC 1	•				•		•	•	•		•	•				•		•											
GC 2		•	•					•					•					•	•										
GC 3		•	•							•		•				•			•										
GC 4	•	•	•		•			•			•	•					•	•											
SC 1							•	•	•											•	•	•	•	•	•	•	•	•	
SC 2		•	•					•	•	•										•	•	•	•	•	•	•	•	•	
SC 3				•		•	•	•	•		•									•	•	•	•	•	•	•	•		
SC 4	•				•							•				•						•		•	•				
SC 5							•	•	•			•								•	•	•	•	•	•	•	•	•	
SC 6				•		•									•		•		•										

• – the competence that the graduate receives;

OC1.j, OC2.j – obligatory components of the educational programme; **OB1.j** – a discipline of the graduate's choice from disciplines that form general scientific competences and universal skills of the researcher; **OB2.j** – disciplines of the optional block that form professional competences; **OB3.1** – a discipline of the graduate's free choice. **INT** – integral competence; **GC_i** – competency number in the list of general program competencies; **SC_i** – competence number in the list of special competences of the educational program.

5. Matrix of insurance of program learning outcomes with relevant components of the educational programme

	OC1.1	OC1.2	OC1.3	OC1.4	OC1.5	OC1.6	OC2.1	OC2.2	OC2.3	OB1.1	OB1.2	OB1.3	OB1.4	OB1.5	OB1.6	OB1.7	OB1.8	OB1.9	OB1.10	OB2.1	OB2.2	OB2.3	OB2.4	OB2.5	OB2.6	OB2.7	OB2.8	OB3.1	
LO 1	•			•		•	•	•	•											•	•	•	•	•	•	•	•		
LO 2		•	•			•		•	•	•	•			•					•	•	•	•	•	•	•	•	•	•	
LO 3							•	•	•						•	•	•			•	•						•		
LO 4							•	•	•		•							•		•	•	•	•	•	•	•	•		
LO 5					•			•	•			•	•					•											
LO 6							•	•	•											•	•	•	•	•	•	•	•		
LO 7								•	•							•		•				•	•	•	•				
LO 8		•	•				•	•					•			•			•				•						
LO 9				•		•						•			•		•		•										
Com 1		•	•	•		•				•		•	•	•		•			•										
A&R 1					•			•			•	•						•											
A&R 2	•			•				•								•													
A&R 3				•	•	•					•	•			•		•	•											

• – the learning outcomes that is provided;

OC1.j, OC2.j – obligatory components of the educational programme; **OB1.j** – a discipline of the graduate's choice from disciplines that form general scientific competences and universal skills of the researcher; **OB2.j** – disciplines of the optional block that form professional competences; **OB3.1** – a discipline of the graduate's free choice. **LOi** – learning outcome number in the list of program learning outcomes; **Com 1** - communication learning outcome; **A&Ri** – autonomy and responsibility outcome number in the list of program learning outcomes.

II. SCIENTIFIC COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

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

The dissertation for obtaining the degree of Doctor of Philosophy is an independent detailed study containing the results of solving a complex problem in the field of automation and computer-integrated technologies, or on its border with other specialties, the results of which have scientific novelty, theoretical and practical significance.

Conducting scientific research by a graduate student must comply with the Regulations on Academic Integrity at Lviv Polytechnic National University.

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

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.

Areas of scientific research by specialty

151 "Automation and computer-integrated technologies":

1. Development and improvement of automation tools, automated control systems for technological processes and complexes for various purposes.
2. Development and methods improvement of managing objects and processes in various fields of activity.
3. Modeling of objects and control systems. Identification of control objects.
4. Development of mathematical, informational, software, and technical support of automated control systems for technological and organizational-technical objects and processes.
5. Development and improvement of computer-integrated technologies.
6. Theoretical foundations and methodology of CAD creation, in particular formalization of design objects, goals and criteria. Algorithmization of design tasks, problematic adaptation of CAD.
7. Mathematical modeling and analysis of technical objects in CAD, in particular methods of object identification, numerical analytical methods of object analysis, modeling of functional capabilities of automation tools and systems.