

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LVIV POLYTECHNIC NATIONAL UNIVERSITY



APPROVED BY

Acting of the rector of Lviv Polytechnic
National University

/Yuriy BOBALO/

« 11 » 03 2025

EDUCATIONAL AND SCIENTIFIC PROGRAM
«ELECTRONICS»

HIGHER EDUCATION LEVEL	third (educational and scientific) level
DEGREE OF HIGHER EDUCATION	Doctor of Philosophy
FIELD OF KNOWLEDGE	G Engineering, manufacturing and construction
SPECIALTY	G5 Electronics, electronic communications, instrument engineering and radio engineering

Considered and approved
at a meeting of the Academic Council of
Lviv Polytechnic National University

« 25 » 02 2025 p.

Protocol № 20

LETTER OF AGREEMENT

educational and professional program

Level of higher education	the third (educational and scientific)
Degree in higher education	Doctor of Philosophy
Doctor of Philosophy	G Engineering, manufacturing and construction
Specialty	G5 Electronics, electronic communications, instrument engineering and radio engineering

DEVELOPED AND APPROVED

Scientific and methodical commission
of the specialty G5 Electronics, electronic
communications, instrument engineering
and radio engineering

Protocol No. 1
from « 14 » 02 2025

Head of the SMC of the specialty G5
Iryna KREMER

AGREED

Vice-rector for scientific work
Ivan DEMYDOV
« 19 » 02 2025

Vice-rector for scientific and
pedagogical works of the National
University "Lviv Polytechnic"
Oleh DAVYDCHAK
« 19 » 02 2025

Head of the Department of Doctoral
Studies and Postgraduate Studies
Olena MUKAN
« 19 » 02 2025

Head of the Educational and
Methodological Department of the
University
Vasyl TOM'YUK
« 19 » 02 2025

RECOMMENDED

Scientific and methodological council of
the university

Protocol No. 85
from « 20 » 02 2025

The head of the SMC of the university
Anatoly ZAHORODNYI

Director of the Educational and
Scientific Institute of Information and
Communication Technologies and
Electronic Engineering
Leonid OZIRKOVSKIY
« 19 » 02 2025

PREFACE

Developed by the Standard of Higher Education in the specialty 171 Electronics for the third (educational and scientific) level of higher education, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated 05/26/2023. No. 634.

Developed by the working group of the scientific and methodical commission of the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering of the National University "Lviv Polytechnic" in the composition of:

Hryhoriy Barylo	- Ph.D., professor, professor of the Department of Electronic Engineering
Yaremchuk Iryna	- Ph.D., professor, head of the Department of electronic engineering
Helzhynskyy Ihor	- Ph.D., professor, professor of the Department of Electronic Engineering
Mykytyuk Zinovii	- Ph.D.-M.Sc., professor, professor of the Department of Electronic Engineering
Pavlo Stakhira	- Ph.D., professor, professor of the Department of Electronic Engineering
Volodymyr Fito	- Ph.D.-M.Sc., professor, professor of the Department of Electronic Engineering
Lishik Faina	- Director of Microprylad-07 State Enterprise
Kushnirenko Andriana	- an organizer from the personnel of the company Renesas Electronics-Ukraine
Yuriy Shlyusar	- holder of higher education with the degree of Doctor of Philosophy, postgraduate student in the 3rd year of studies in the specialty 171 "Electronics"
Andriy Hrynychshyn	- recipient of higher education with the degree of Doctor of Philosophy, postgraduate student in the 1st year of study, specialty 171 "Electronics"

Guarantor of the educational and scientific program

Hryhoriy BARYLO

The project of the educational and scientific program was discussed and approved at the meeting of the Academic Council of the Educational and Scientific Institute of Information and Communication Technologies and Electronic Engineering

Protocol No. 6 of «20» 02 2025 year.

Chairman of the Scientific Council of ICTE  Leonid OZIRKOVSKYI

The project of the educational and scientific program was discussed and approved at the meeting of the NMR of the Educational and Scientific Institute of Information and Communication Technologies and Electronic Engineering

Protocol No. 6 of «19» 02 2025 year.

Head of NMR ICTE  Mykola KAIDAN

APPROVED AND ENACTED by order acting of the rector of the Lviv Polytechnic National University.

from «11» 03 2025 No. 146-1-10.

This educational and scientific program may not be fully or partially reproduced, duplicated, or distributed without the permission of Lviv Polytechnic National University.

1. Profile of the Doctor of Philosophy program from specialty *G5 Electronics, electronic communications, instrument engineering and radio engineering*

1 - General information	
1	2
Full name of the higher education institution and structural unit	Lviv Polytechnic National University, Department of Electronic Engineering, Institute of Information and Communication Technologies and Electronic Engineering
Level of higher education	The third (educational and scientific) level
Degree in higher education	Doctor of Philosophy
Branch of knowledge	G Engineering, manufacturing and construction
Specialty	G5 Electronics, electronic communications, instrument engineering and radio engineering
Forms of Obtaining Education	Full-time, part-time
Educational Qualification	Doctor of Philosophy in Electronics, electronic communications, instrument engineering and radio engineering
Professional qualification	
Qualification in diploma	The degree of higher education is a Doctor of Philosophy Field of knowledge - G Engineering, manufacturing and construction Specialty - G5 Electronics, electronic communications, instrument engineering and radio engineering
Description of the subject area	<p>Object(s) of study and/or activity: physical processes and phenomena, schematic and system engineering solutions, which are the basis for the functioning of electronic components, devices, and systems. Learning goals: acquiring the ability to produce new ideas, to solve complex problems of professional and research-innovative activity in the field of electronics, to apply the methodology of the scientific and pedagogical activity, to carry out own scientific research, the results of which have scientific novelty, theoretical and practical significance.</p> <p>The theoretical content of the subject area: fundamental principles, concepts of construction, modeling, and design of modern electronic components and systems.</p> <p>Methods, techniques, and technologies: research of processes in electronic devices, and systems; data analysis experiment planning, development, and justification of schematic and/or software solutions, modern digital technologies, methods of physical, mathematical, and computer modeling, methods of machine learning, artificial intelligence, and cloud computing.</p> <p>Tools and equipment: electronic components, devices, and systems, control and measuring equipment, control and regulation systems, power supply of electronic equipment, display, and registration of information, electronic systems for various purposes, computer and microprocessor equipment, specialized software</p>
Academic rights of graduates	Obtaining a Doctor of Science degree and additional qualifications in the adult education system.
Employment graduates	Employment in the positions of scientific and scientific-pedagogical workers in scientific institutions and institutions of higher education, as well as in the positions of highly qualified workers in research, design, construction, etc. institutions and divisions of enterprises.

Requirements for the level of education of persons who can start studying in the educational programs of the specialty 171 Electronics, and their study results	<p>Persons who have obtained the educational level of «master» can obtain the educational and scientific level of Doctor of Philosophy in the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering.</p> <p>The program of professional entrance examinations for persons who have obtained a previous level of higher education in other specialties should provide for verification of the person's acquisition of competencies and their achievement of the learning results determined by the standard of higher education in the specialty 171 Electronics for the second (master's) level of higher education.</p>
The amount of ECTS credits required to obtain the corresponding degree of higher education	<p>The educational and scientific program for the training of a Doctor of Philosophy consists of educational and scientific components. The standard period of training for a Doctor of Philosophy in postgraduate studies is four years.</p> <p>43 ECTS credits of the educational and scientific program of the Doctor of Philosophy.</p>
Availability of accreditation	Accredited
Cycle/level	NRK of Ukraine – 8th level, FQ EHEA – third cycle, EQF
Teaching language(s)	Ukrainian
Basic concepts and their definitions	<p>The educational and scientific program uses the main concepts and their definitions by the Law of Ukraine "On Higher Education" dated 07/01/2014 No. 1556-VII as amended, the Law of Ukraine "On Scientific and Scientific and Technical Activities" dated 11/26/2015 r. No. 848-VIII with amendments and additions, Procedure for the training of higher education applicants for the degree of Doctor of Philosophy and of Doctor of Sciences in higher educational institutions (scientific institutions), approved by Resolution of the Cabinet of Ministers No. 261 dated 23.03.2016, 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 (minutes dated 29.03. No. 3 of 2016) and the Standard of Higher Education in the specialty 171 Electronics for the third (educational and scientific) level of higher education, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated May 26, 2023. No. 634.</p>
2 – The purpose of the educational and scientific program	
	<p>Deep theoretical knowledge and practical skills and abilities in the field of electronics and telecommunications, specializing in electronics; developing the philosophical and linguistic competencies; forming universal skills of a researcher, sufficient for conducting and successfully completing scientific research and further professional and scientific activities.</p>
3 - Characteristics of the educational program	
Orientation of the educational program	The educational and scientific program is aimed at relevant aspects of the specialty, within which a further scientific and teaching career is possible.
The main focus of the educational program and specialization	The scientific component of the educational and scientific program is determined by the graduate student's study plan.
Features and differences	The goals of the EP are the training of specialists capable of solving complex problems in the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering.

	The uniqueness of the EP is in the training of highly qualified scientific and pedagogical personnel capable of solving complex problems of the specialty, carrying out scientific, research-innovative, and teaching activities, as well as implementing the obtained results in the field of electronics and telecommunications. Namely, the formation of a specialist capable of solving complex tasks related to the design and construction of electronic devices, methods of designing and modeling electronic devices and systems at a high scientific and research level of professional activity.
4 - Eligibility of graduates of the educational and scientific program to employment and further education	
Suitability for employment	Employment in research institutes of the National Academy of Sciences of Ukraine, higher educational institutions of the Ministry of Education of Ukraine, scientific centers and high-tech companies, electronics, and telecommunications enterprises.
Further education	The scientific program of the fourth (scientific) level of higher education "Doctor of Sciences"
5 - Teaching and assessment	
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	Exams, assessments, current control
6 - List of graduate competencies	
Integral competence	The ability to produce new ideas, to solve complex problems of professional and/or research and innovation activities in the field of electronics, to apply the methodology of scientific and pedagogical activities, to conduct their scientific research, the results of which have scientific novelty, theoretical and practical significance.
General competences	GC1. Ability to abstract thinking, analysis, and synthesis. GC 2. Ability to search, process and analyze information from various sources. GC 3. Ability to work in an international context
Special (professional) competences	SC1. Ability to perform original research, and achieve scientific results that create new knowledge in electronics and related interdisciplinary areas and can be published in leading scientific publications in electronics and related fields. SC2. Ability to develop theoretical principles, create and apply modern objects and processes of electronics. SC3. The ability to commercialize the results of research in the field of electronics. SC4. Ability to use modern research tools and methods, methods of modeling, data analysis and optimization, decision-making systems, digital technologies, databases, and other electronic resources, and specialized software for the study of objects and processes of electronics. SC5. Ability to initiate, develop and implement complex innovative electronics and related interdisciplinary projects. SC6. The ability to carry out scientific and pedagogical activities in higher education.

7 - The normative content of the preparation of the Doctor of Philosophy, formulated in terms of learning outcomes

ER1. Advanced conceptual and methodological knowledge in electronics and interdisciplinary subjects, as well as research skills sufficient for conducting scientific and applied research at the level of the latest world achievements in the relevant field, obtaining new knowledge, and using it in one's own research and teaching practice.

ER 2. Ability to present and discuss with specialists and non-specialists the results of research, scientific, and applied problems of electronics in national and foreign languages and publish the results of research in scientific publications in leading international scientific publications.

ER 3. Ability to formulate and test hypotheses; use appropriate evidence to substantiate conclusions, particularly the results of theoretical analysis, experimental studies, physical, mathematical, and computer modeling, and available references.

ER 4. Ability to develop and research conceptual, mathematical, and computer models of processes and systems, effectively use them to obtain new knowledge and/or create innovative products in electronics and related interdisciplinary areas, in scientific and pedagogical activities.

ER 5. Ability to plan and carry out experimental and/or theoretical research in electronics and related interdisciplinary areas using modern theories, methods, tools, and digital technologies, in compliance with the norms of academic and professional ethics, critically analyze the results of own research and the results of other researchers in the context of the entire complex of modern knowledge about the researched problem.

ER 6. Ability to plan and organize work in the field of scientific research, development, analysis, calculation, modeling, production, and testing of electronic devices and systems.

ER 7. Ability to organize and manage research, innovation, and investment activities, business projects, and production processes taking into account technological indicators, market requirements, existing standards, the competitiveness of scientific and engineering products, rules of professional ethics, and academic integrity.

ER 8. Ability to use modern tools and technologies for searching, processing, and analyzing information, in particular, statistical methods for analyzing large volumes of data and/or complex structures, specialized databases, and information systems.

ER 9. Ability to develop and implement scientific and/or innovative engineering projects that provide an opportunity to rethink existing and create new integral knowledge and/or professional practice and to solve significant scientific and technological problems of electronics, taking into account engineering, social, economic, environmental, and legal aspects.

ER 10. Ability to identify actual scientific and practical problems in the field of electronics, to deeply understand the general principles and methods of electronics, as well as the methodology of scientific research, to apply them in one's own research in the field of electronics and teaching practice.

ER 11. Ability to organize and carry out the educational process in the field of electronics, its scientific, educational, methodological, and normative support, to develop and teach special educational disciplines in institutions of higher education.

Knowledge (Kn)	Kn1. Conceptual and methodological knowledge in the field or on the border of fields of knowledge or professional activity
Skill (Sk)	<p>Sk1. Specialized abilities/skills and methods needed to solve significant problems in the field of professional activity, science, and/or innovation, expansion, and reassessment of already existing knowledge and professional practice.</p> <p>Sk2. Initiate, plan, implement, and adjust a consistent process of thorough scientific research with due academic integrity.</p> <p>Sk3. Critical analysis, evaluation, and synthesis of new and complex ideas.</p>
Communication (C)	<p>C1. Free communication on issues related to the field of scientific and expert knowledge with colleagues, the wider scientific community, and society.</p> <p>C2. Use of academic Ukrainian and foreign languages in professional activity and research.</p>

Responsibility and Autonomy (RA)	<p>RA1. Demonstration of significant authority, innovativeness, a high degree of independence, academic and professional integrity, and consistent commitment to the development of new ideas or processes in advanced professional and scientific contexts.</p> <p>RA2. Ability to continuously self-development and self-improvement.</p>
8 – Resource support for the implementation of the educational program	
The main characteristics of personnel software	100% of the teaching staff involved in teaching professionally oriented disciplines have scientific degrees in their specialty
The main characteristics of the material and technical support	Modern equipment and electronic components of leading companies STMicroelectronics, Cypress, and Analog Devices. UVR-3M device for creating organic structures, VUP-5M deposition of metal contacts, 4145A - semiconductor parameter analyzer - a complex for measuring the electrophysical characteristics of LEDs and transistors.
Main characteristics of informational and methodological support	The use of the virtual learning environment of the National University "Lviv Polytechnic" and the author's developments of the teaching staff.
9 – Academic mobility	
National credit mobility	Based on bilateral agreements between Lviv Polytechnic National University and the universities of Ukraine.
International credit mobility	Within the EU Erasmus+ program, based on bilateral agreements between Lviv Polytechnic National University and educational institutions of partner countries.
Education of foreign students of higher education	Possible

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

No s/p	Training cycles	The amount of study load of a graduate student (credits / %)		
		Compulsory educational component	Optional educational component	The total number for the entire period of study
1.	The cycle of disciplines that form general scientific competencies and universal skills of the researcher	21/49	3/7	24/56
2.	The cycle of disciplines forming professional competences	10/23	6/14	16/37
3.	The 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

ED Code	Components of the educational component	Number of credits	Final assessment form	Competences provided for by Resolution 261 of March 23, 2016. (with changes from 04/03/2019)
1	2	3	4	5
Mandatory components of the educational component				
<i>The cycle of disciplines that form general scientific competencies and universal skills of the researcher</i>				
CC1.1.	Philosophy and Methodology of Science	3	exam	Mastering general scientific (philosophical) competencies aimed at forming a systematic scientific outlook, professional ethics, and a general cultural outlook; application of modern information technologies in scientific activities (work with NMBD, automatic generation of links to literary sources, etc.).
CC1.2.	Academic Foreign Language, part 1	4	test	Acquisition of linguistic competencies is sufficient to present and discuss the results of one's scientific work in a foreign language in oral and written form, as well as to fully understand foreign language scientific texts in the relevant specialty, use of modern information technologies (presentation of scientific results).
CC1.3.	Academic Foreign Language, part 2	4	exam	
CC1.4.	Professional Pedagogy	3	test	Acquisition of universal skills of a researcher organization and conduct of training sessions, use of modern information technologies (working with VNS, Microsoft Teams, Zoom, etc.).
CC1.5.	Academic Entrepreneurship	4	test	Acquisition of universal researcher skills, oral and written presentation of the results of one's scientific research in Ukrainian, management of scientific projects and/or preparation of proposals for financing scientific research, registration of intellectual property rights, and application of modern information technologies.
CC1.6.	Pedagogical Practice	3	test	Acquisition of universal skills of a researcher organization and conduct of training sessions, use of modern information technologies (working with VNS, Microsoft Teams, Zoom, etc.).
Total per cycle:		21		
<i>The Cycle of disciplines forming professional competencies*</i>				
1	2	3	4	5
CC2.1.	Analytical and Numerical Research Methods	3	exam	Acquiring in-depth knowledge of the specialty in which the graduate student conducts research assimilation of basic concepts, understanding of theoretical and practical problems, the history of development and the current state of scientific knowledge in the chosen
CC2.2.	Research Seminar in the Field of Electronics and	3	test	

	Telecommunications (discussion of publications, research in the field, novelties, discoveries, etc.)			specialty, mastering the terminology of the researched scientific direction in the amount of ECTS credits by the standard of higher education.
CC2.3.	Research Methods in Electronics	4	test	
Total per cycle:		10 (3+3+4)		
Optional educational component*				
The cycle of disciplines that form general scientific competencies and universal skills of the researcher*				
OC1.1	Business Foreign Language	3	test	<p>Acquisition of universal researcher skills, oral and written presentation of the results of one's scientific research in Ukrainian, management of scientific projects and/or preparation of proposals for financing scientific research, registration of intellectual property rights, and application of modern information technologies.</p> <p>Acquisition of linguistic competencies is sufficient to present and discuss the results of one's scientific work in a foreign language in oral and written form, as well as to fully understand foreign language scientific texts in the relevant specialty, use of modern information technologies (presentation of scientific results).</p> <p>Mastering general scientific (philosophical) competencies aimed at forming a systematic scientific outlook, professional ethics, and a general cultural outlook; application of modern information technologies in scientific activities (work with NMBD, automatic generation of links to literary sources, etc.).</p> <p>Acquisition of universal skills of a researcher, in particular, organization and conduct of training sessions, use of modern information technologies (working with VNS, Microsoft Teams, Zoom, etc.).</p>
OC1.2	Psychology of Creativity and Invention	3	test	
OC1.3	Management of Scientific projects	3	test	
OC1.4	The technology of Registration of Grant Applications and Patent Rights	3	test	
OC1.5	Rhetoric	3	test	
OC1.6	Modern Inventions in Research Activities	3	test	
OC1.7	Open Scientific Practices	3	test	
OC1.8	Academic Integrity and Quality of Education	3	test	
OC1.9	Methodology of Preparation of Scientific Publications	3	test	
OC1.10	Quality of Higher Education (formation of internal quality assurance systems)	3	test	
Total per cycle:		3		
The Cycle of disciplines forming professional Competencies **				
OC2.1	Mathematical Modeling and Prediction of the Experiment	3	exam	<p>Acquiring in-depth knowledge of the specialty in which the graduate student conducts research mastering the main concepts, understanding theoretical and practical problems, the history of development, and the current state of scientific knowledge in the chosen specialty, mastering the terminology of the researched scientific direction.</p>
OC2.2	Physical Experiment Technique	3	exam	
OC2.3	Microelectronic Sensors of Physical Quantities	3	exam	
OC2.4	Microcircuitry and Signal Converters	3	exam	

OC2.5	Biomedical Electronics	3	exam
OC2.6	Microprocessor Control Systems	3	exam
OC2.7	Organic Electronics	3	exam
OC2.8	Alternative Energy Sources	3	exam
OC2.9	Nanoelectronics	3	exam
OC2.10	Liquid Crystal Electronics	3	exam
Total per cycle:		6 (3+3)	
Disciplines of the graduate student's free choice ***			
OC3.1	The discipline of the graduate student's free choice	3	test
Total per cycle:		3	
TOGETHER		43	

Note:

* - disciplines that form professional competencies (OK2.1 and OK2.2.) are offered jointly for ONPs of related fields and specialties, discipline OK2.3 - within the same specialty.

** - The list of optional disciplines forming professional competencies must contain at least eight 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. The scientific component of the educational and scientific program

The scientific component of the educational-scientific program involves the post-graduate student conducting his 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 comprehensive study that offers a solution to an actual scientific and applied task in the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering, the results of which are characterized by scientific novelty and practical value and are published in relevant publications.

The scientific component of the educational-scientific program is drawn up in the form of an individual plan of scientific work 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.

Topics of scientific research in the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering:

1. Micropower signal converters of sensor devices.
2. Nodes of programmable systems on a crystal.
3. Microelectronic temperature sensors.
4. Signal converters of photovoltaic devices.
5. Development of integrated elements and circuits based on organic semiconductors and conjugated polymers.
6. Use of alternative technologies for the construction of displays and lighting systems.
7. Research of sensor structures based on active elements of organic electronics.
8. Research of electrically controlled liquid crystal optical systems.
9. Research of primary converters of sensors based on polymer-dispersed liquid crystal materials.
10. Modification of optically active media of information display devices.

5. Forms of attestation of higher education applicants

Forms of attestation of applicants of higher education	Certification of applicants is carried out in the form of a public defense of a dissertation.
Dissertation requirements for obtaining the degree of Doctor of Philosophy	<p>The dissertation for the degree of Doctor of Philosophy is an independent detailed study that offers a solution to a complex problem in the field of electronics or interdisciplinary specialties, and the results of which are of scientific novelty, theoretical and practical significance.</p> <p>The dissertation should not contain academic plagiarism, falsification, or fabrication.</p> <p>Dissertations of persons receiving a Ph.D. degree and reviews on them are published on the official website of the relevant institution of higher education or scientific institution by the law.</p>

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

The volume of the main text of the thesis of applicants for higher education for the degree of Doctor of Philosophy in the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering is set in the number of 3.5 - 5 author's sheets.

A prerequisite for admission to defense is the successful completion of an individual curriculum by a postgraduate student. The work of graduate students is based on the principles of academic virtue: observance of the culture of scientific integrity in all types of scientific activity and observance of ethical standards; awareness of responsibility for the emergence of danger for individuals or society as a whole with the use of unverified new scientific knowledge; impeccable honesty and transparency at all stages of scientific research (in compliance with the requirements of copyright, the national interests of Ukraine, state secrets), the inadmissibility of plagiarism, self-plagiarism, falsification and fabrication of data.

6. Matrix of correspondence of program competencies to the components of the educational program

Components of the educational program	Competences								
	Integral competence								
	General competences			Special (professional) competences					
	GC1	GC2	GC3	SK1	SK2	SK3	SK4	SK5	SK6
CC1.1	•			•				•	
CC1.2		•	•	•					
CC1.3		•	•	•					
CC1.4	•				•				•
CC1.5		•			•	•		•	
CC1.6	•			•					•
CC2.1	•			•			•		
CC2.2		•		•			•		
CC2.3		•		•	•				
OC1.1		•	•	•					
OC1.2	•							•	•
OC1.3	•			•				•	
OC1.4		•	•		•				
OC1.5		•						•	•
OC1.6	•				•			•	
OC1.7	•			•			•		
OC1.8	•								•
OC1.9		•		•			•		
OC1.10	•	•							•
OC2.1		•		•			•		
OC2.2		•		•			•		
OC2.3	•	•			•				
OC2.4		•				•		•	
OC2.5		•			•		•		
OC2.6	•	•					•		
OC2.7		•		•				•	
OC2.8		•		•				•	
OC2.9	•				•			•	
OC2.10		•			•			•	

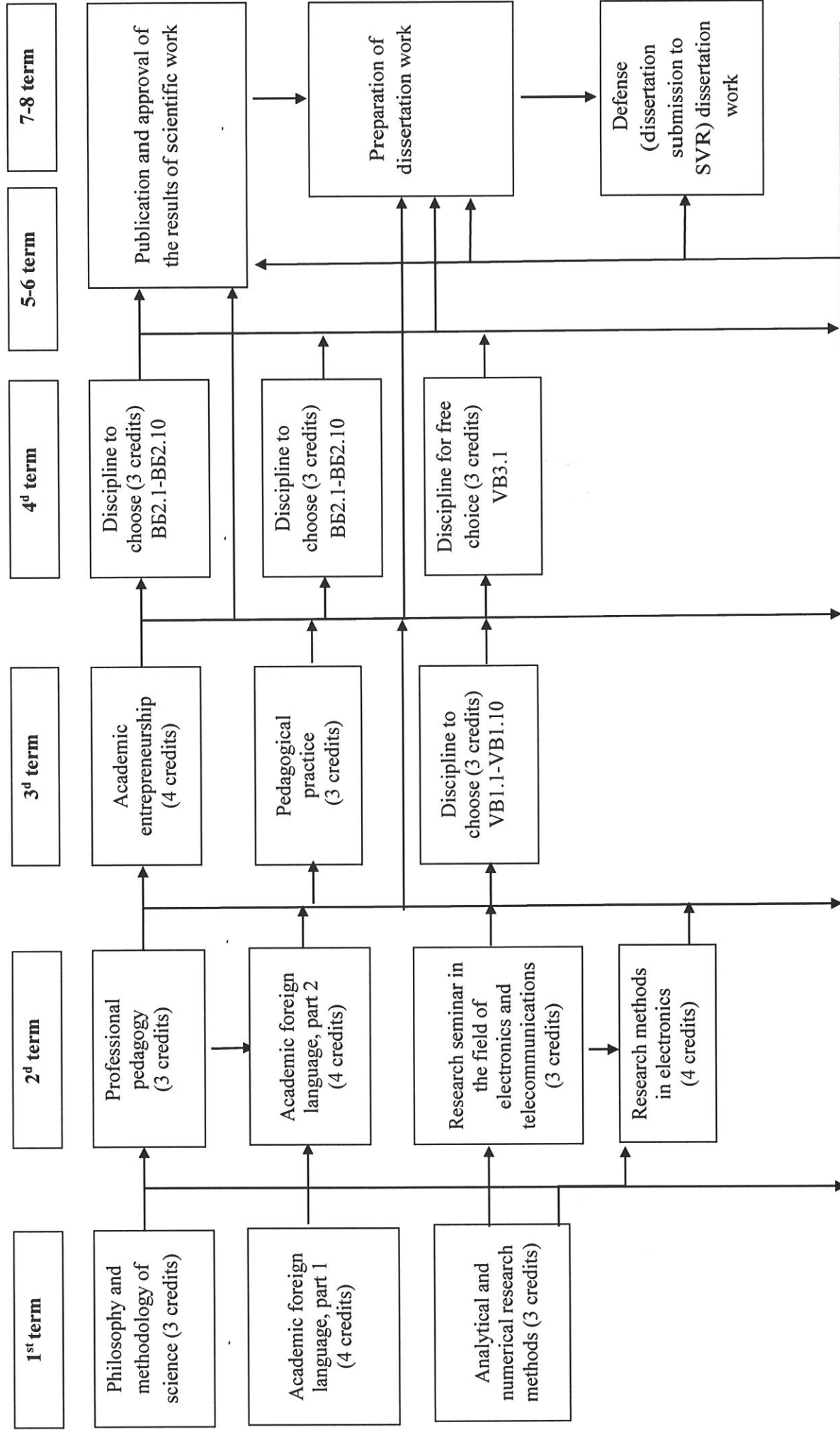
Legend: • - acquired competence; INT - integral competence; GCj – general competence; SKj - special (professional) competence; j – competency number in the list of competencies of the educational component; CCi - is a mandatory discipline, OCi - is an optional discipline, i - is the number of the discipline in the list of components of the educational component.

7. Matrix of provision of program learning results corresponding components of the educational program

Learning outcomes	CC1.1	CC1.2	CC1.3	CC1.4	CC1.5	CC1.6	CC2.1	CC2.2	CC2.3	OC1.1	OC1.2	OC1.3	OC1.4	OC1.5	OC1.6	OC1.7	OC1.8	OC1.9	OC1.10	OC2.1	OC2.2	OC2.3	OC2.4	OC2.5	OC2.6	OC2.7	OC2.8	OC2.9	OC2.10
ER1				•		•											•										•		
ER2		•	•					•		•									•										
ER3	•																			•						•			
ER4							•	•												•								•	
ER5																					•							•	
ER6																•						•							
ER7					•										•			•											
ER8							•		•												•								
ER9					•	•							•																
ER10						•			•																				
ER11				•		•					•																		
Kn1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sk1								•				•																	
Sk2																													
Sk3									•																				
C1	•			•							•		•	•															
C2		•	•							•																			
RA1												•																	
RA2	•				•																								

Legend: Kn – knowledge; Sk – skill; C – communication; RA – responsibility and autonomy.

Structural and logical scheme of the educational and scientific program of the Doctor of Philosophy in the specialty G5 Electronics, electronic communications, instrument engineering and radio engineering



Scientific research on the topic of the dissertation