MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LVIV POLYTECHNIC NATIONAL UNIVERSITY

APPROVED BY
Rector of Lviv Polytechnic
National University
_____ /Bobalo Yu.Ya./
«_____» _____ 2021

EDUCATIONAL AND SCIENTIFIC PROGRAM

third (educational and scientific) level of higher education

in specialty 171 «Electronics»

field of knolwledge 17 «Electronics and telecommunications»

Qualification: Doctor of Philosophy in specialty «Electronics»

Considered and approved
at a meeting of the Academic Council of
Lviv Polytechnic National University
«___» _____ 2021
Protocol №____

Lviv 2021

The Program was developed by the next working group for the specialty 171 «Electronics»:

Project Team Leader(Guarantor): Barylo H.I.	- D.Sc., Docent of the Department of Electronics Devices
Members:	
Mykytyuk Z.M.	- D.Sc., Prof., Professor of the Department of Electronics Devices
Stakhira P. Y.	- D.Sc., Prof., Professor of the Department of Electronics Devices
Kremer I.P.	- Ph.D., Docent of the Department of Electronics Devices
Krukovsky S.I.	- Head of department Research and Production Enterprise "Electron-Karat"
Kutsii S.A.	- 4th-year Ph.D. student of specialty 171 «Electronics»

Guarantor _____ D.Sc., Docent Barylo H.I.

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by the order of Rector of Lviv Polytechnic National University Lviv
«____» _____ 2021 № _____.

LETTER OF AGREEMENT
educational and scientific program

Level of higher education	Third (educational and scientific)
Field of knowledge	17 *Electronics and telecommunications*
Specialty	171 *Electronics*
Qualification	Doctor of Philosophy

APPROVED

Scientific and methodical commission of specialty 171 “Electronics”
Protocol No._____
«____» _____ 2021

Head of the NMC of the specialty
171 “Electronics”
_____ Mykytyuk Z.M.
«__» _____ 2021

Head of the Institute of Telecommunications, Radioelectronics and Electronic Engineering
_____B.M. Strykhaliuk
«____» _____ 2021

AGREED

Head of the educational and methodical department
_____ Sviridov V.M.
«____» _____ 2021

Vice-rector for scientific work

_____ Demidov I.V.
«____» _____ 2021

Vice-rector for scientific fnd pedagogical work

_____ Davydchak O.R.
«__» _____ 2021 p.

RECOMMENDED
Scientific and methodological council of Lviv Polytechnic National University
Protocol No._____
«____» _____ 2021
_____ A.H. Zahorodnyi

I. Educational component of educational-scientific programme
1. Profile of the Doctor of Philosophy program in Speciality of «Electronics»

1 – General information	
1	**2**
Full name of the higher education institution and structural unit	**Lviv Polytechnical National University**
The full title of the qualification in the original language	**Doctor of Philosophy in electronics and telecommunication in profession of electronics**
The official name of the educational program	Electronics
Type of diploma and scope of the educational program	Diploma of Doctor of Philosophy, single, 43 ECTS credits, term of the educational component of the educational and scientific program 2 years
Cycle/level	NFQ –level 8, FQ-EHEA – third cycle, EQF-LLL – level 8
Prerequisites	Master's level
Language(s)	Українська мова
Основні поняття та їх визначення	The educational and scientific program uses the main concepts and their definitions in accordance with the Law of Ukraine "On Higher Education" dated 07/01/2014 No. 1556-VII with amendments and additions, the Law of Ukraine "On Education" dated 09/05/2017 No. 2145-VIII with amendments and additions to the Law of Ukraine "On Scientific and Scientific-Technical Activities" dated 26.11.2015 No. 848-VIII as amended, Procedures for the Training of Higher Education Candidates for Doctor of Philosophy and Doctor of Science Degrees in Higher Education Institutions (Scientific Institutions), approved by Resolution of the Cabinet of Ministers of Ukraine dated 23.03.2016 No. 261 with changes and additions, the Procedure for conducting an experiment on awarding the degree of Doctor of Philosophy, approved by Resolution of the Cabinet of Ministers of Ukraine dated 03.06.2019 No. 167, Methodological recommendations for the development of higher education standards, approved by the Order of the Ministry of Education and Science of Ukraine dated June 1, 2017 No. 600 with changes and additions
2 – The purpose of the educational program	
	To deepen theoretical knowledge and practical skills in the field of electronics and telecommunications in the speciality of electronics, to develop philosophical and linguistic competencies, to form universal research skills sufficient to conduct and successfully complete scientific research and further professional and scientific activities
3 - - Characteristics of the educational program	
Subject area (field of knowledge, specialty)	Field of knowledge 17 "Electronics and telecommunications", speciality 171 "Electronics"
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.
Features and differences	The scientific component of the educational and scientific program is determined by the individual study plan of the graduate student

Continuation of Table

1	2
4 – Suitability of graduates of the educational program to employment and further education	
Suitability for employment	Jobs at research institutes of the National Academy of Sciences of Ukraine, higher education institutions of the Ministry of Education and Science of Ukraine, research centres and high-tech companies, electronics and telecommunications enterprises.
Further education	Research programme of the fourth (scientific) level of higher education "Doctor of Science"
5 – Teaching and assessment	
Teaching and learning	Combination of lectures and practical classes, pedagogical workshops, consultations with the supervisor and the scientific and pedagogical community with independent research and educational work
Assessment	Written and oral exams, assessments, oral presentations
6 – Program competencies	
Integral competence	The ability to solve complex problems in the field of electronics and telecommunications, to conduct research and innovation activities that involve a deep rethinking of existing and creation of new holistic knowledge, as well as practical implementation of the results obtained.
General competences	1.Systematic knowledge of modern methods of research in the field of electronics and electronic engineering. 2.Critical analysis, evaluation and synthesis of new ideas. 3.Ability to communicate effectively with the general scientific community and the public on topical issues of electronics, elements and devices of electronic equipment. 4.Ability to self-develop and self-improve throughout life, responsibility for teaching others. 5.Social responsibility for the results of strategic decision-making. 6.Initiating original research and innovation complex projects. 7.Leadership and the ability to work both autonomously and in a team during project implementation.
Professional competencies	1. Knowledge of current development trends and the most important new scientific achievements in the field of electronics and telecommunications, as well as related fields. 2. Systematic knowledge and understanding of modern scientific theories and methods, and the ability to effectively apply them to the development and analysis of elements, devices and systems of electronic equipment. 3. Ability to effectively apply methods of analysis, mathematical modelling, perform physical and mathematical experiments in conducting research; 4. Ability to integrate knowledge from other disciplines, apply a systematic approach and take into account non-technical aspects in solving engineering problems and conducting research; 5. Ability to develop and implement projects, including own research, which allow to rethink existing or create new knowledge; 6. Ability to justify the choice of method for solving a specialised problem, critically evaluate the results obtained and defend the decisions made.

Continuation of Table

1	2
7 – Programme learning outcomes	
Knowledge	1. Ability to demonstrate systematic knowledge of modern methods of research in the field of electronics and electronic engineering. 2. Ability to demonstrate in-depth knowledge in the chosen field of research. 1. 3. Ability to demonstrate an understanding of the impact of technical solutions in the social, economic and social context.
Abilities	1.Search for, analyse and critically evaluate information from various sources. 2.Apply knowledge and understanding to solve problems of synthesis and analysis of elements and systems characteristic of the chosen field of research. 3.Investigate and model phenomena and processes in complex electronic systems. 4.To apply a systematic approach, integrating knowledge from other disciplines and taking into account non-technical aspects, in solving theoretical and applied problems of the chosen field of research. 5.To combine theory and practice, as well as to make decisions and develop a strategy for solving scientific and applied problems, taking into account universal human values, public, state and industrial interests. 6.To work effectively both individually and as part of a team. 7.Independently carry out experimental research and apply research skills. 8.To assess the feasibility and possibility of applying new methods and technologies for the development of electronic components and devices. 9. Argue the choice of methods for solving a scientific and applied problem, critically evaluate the results obtained and defend the decisions made
Communication	1.Ability to communicate effectively at professional and social levels;. 2. Ability to present and discuss the results obtained and transfer the acquired knowledge.
Autonomy and responsibility	1.The ability to adapt to new conditions, make decisions independently and initiate original research and innovation integrated projects. 2.The ability to recognise the need for lifelong learning in order to deepen the acquired and acquire new professional knowledge. 3. Ability to take responsibility for the work performed and achieve the 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

Continuation of Table

1	2
Specific characteristics of material and technical support	Modern equipment and electronic components of leading companies, e.g., STMicroelectronics, Cypress, Analog Devices. Modern equipment and electronic components of leading companies, e.g. STMicroelectronics, Cypress, Analog Devices, UVR-3M - organic structure creation unit, VUP-5M - deposition of metal contacts, 4145A - semiconductor parameter analyser - a complex for measuring the electrophysical characteristics of LEDs and transistors.
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	Based on bilateral agreements between Lviv Polytechnic National University and the Technical University of Ukraine
International credit mobility	In the framework of Erasmus+ program based on bilateral agreements between Lviv Polytechnic National University and schools partner countries
Education of foreign students of higher education	is possible

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

№ з/п	Цикли підготовки	The amount of study load of a graduate student (credits / %)		
		Mandatory components of the educational program	Elective components of the educational program	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.	The cycle of disciplines of free choice of a postgraduate student	-	3/7	3/7
In total or the entire term teaching		31/72	12/28	43/100

List of components of the educational component of the educational and research program

Code of academic discipline	Components of educ	Number of credits	Final control form
1	2	3	4
Mandatory components of the educational program			
1.1. Cycle of disciplines that form general scientific competences and universal skills of the researche			
ОК1.1.	Philosophy and Methodology of Science	3	exam
ОК1.2.	English Language For Academic Purposes, part 1	4	test exam
ОК1.3.	English Language For Academic Purposes, part 2	4	exam
ОК1.4.	Professional Pedagogy	3	test exam
ОК1.5.	Academic Entrepreneurship	4	test exam
ОК1.6.	Teaching Practice	3	test exam
Total per cycle:		**21**	
Cycle of disciplines forming professional competences			
ОК2.1.	Analytical and numerical methods of research	4	exam
ОК2.2.	Research seminar in the field of electronics and telecommunications (discussion of publications, research in the field, innovations, discoveries, etc.)	3	test exam
ОК2.3.	Research methods in electronics	3	test exam
Total per cycle:		**10**	
Elective components of the educational program			
1.2. Cycle of disciplines that form general scientific competences and universal skills of the researcher			
ВБ1.1	Business Foreign Language	3	test exam
ВБ1.2	Psychology of Creativity and Invention	3	test exam
ВБ1.3	Management of Scientific Projects	3	test exam
ВБ1.4	Technology of Processing Grant Applications and Patents	3	test exam
ВБ1.5	Rhetoric	3	test exam
ВБ1.6	Modern Inventical Management in Scientific and Research Activities	3	test exam
ВБ1.7	Open Science Practices	3	test exam
ВБ1.8	Academic Integrity and Education Quality	3	test exam
ВБ1.9	Methodology of Scientific Paper Publishing	3	test exam
ВБ1.10	Quality of Higher Education (Internal Quality Assurance Systems)	3	test exam
Total per cycle:		**3**	
Cycle of disciplines forming professional competences			
ВБ2.1	Mathematical modelling and forecasting of the experiment	3	exam
ВБ2.2	Technique of physical experiment	3	exam
ВБ2.3	Microelectronic sensors of physical quantities	3	exam
ВБ2.4	Microelectronics and signal converters	3	exam
ВБ2.5	Biomedical electronics	3	exam
ВБ2.6	Microprocessor control systems	3	exam
ВБ2.7	Organic electronics	3	exam
ВБ2.8	Alternative energy sources	3	exam
ВБ2.9	Nanoelectronics	3	exam
ВБ2.10	Liquid crystal electronics	3	exam
Total per cycle:		6 (3+3)	
Disciplines at the discretion of the graduate student			
ВБ3.1	Discipline of free choice of a postgraduate student	3	
Total per cycle:		**3**	
TOTAL		**43**	

II. The scientific component of the educational and scientific program

The scientific component of the educational and research programme involves a postgraduate student conducting their own research under the guidance of one or two supervisors and presenting its results in the form of a dissertation.

The dissertation for the degree of Doctor of Philosophy is an independent detailed research that offers a solution to an actual scientific and applied problem in the speciality 171 Electronics, the results of which are characterised by scientific novelty and practical value and are published in relevant publications.

The scientific component of the educational and research programme is drawn up in the form of an individual plan of research work of a graduate student and is an integral part of the curriculum of the postgraduate study.

An integral part of the scientific component of the educational and scientific programme 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 the specialty 171 "Electronics":

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

III. Certification of applicants

Certification of applicants for higher education with the degree of doctor of philosophy is carried out by a specialized scientific council, permanently active or formed for a one-time defense, on the basis of a public defense of scientific achievements in the form of a thesis.

A mandatory condition for admission to the defense is the successful completion of the graduate student's individual study plan.

Candidates of higher education for the degree of Doctor of Philosophy defend their thesis, as a rule, in a permanent specialized academic council for the relevant specialty, which functions in the higher educational institution where the graduate

student was trained. The academic council of a higher educational institution has the right to submit documents to the National Agency for Higher Education Quality Assurance for the accreditation of a specialized academic council formed for a one-time defense, or to apply to another higher educational institution where a permanent specialized academic council in the relevant specialty operates.

The volume of the main text of the dissertation of applicants for the degree of Doctor of Philosophy in the specialty 171 "Electronics" should be set at 3.5 - 5 author's sheets.

4. Матриця відповідності програмних компетентностей навчальним компонентам

	SK1.1.	SK1.2.	SK1.3.	SK1.4.	SK1.5.	SK1.6.	SK2.1.	SK2.2.	SK2.3.	B1.1.	B1.2.	B1.3.	B1.4.	B1.5.	B1.6.	B1.7.	B1.8.	B1.9.	B1.10.	B2.1.	B2.2.	B2.3.	B2.4.	B2.5.	B2.6.	B2.7.	B2.8.	B2.9.	B2.10.
INT	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
GC1							•		•										•										
GC2	•					•											•												
GC3	•				•	•					•	•																	
GC4	•			•		•					•			•		•		•		•									
GC5		•	•							•				•															
GC6	•					•					•														•				
GC7	•					•					•	•	•				•												•
FC1							•		•						•				•										
FC2					•			•									•												
FC3																				•	•	•	•	•	•	•	•	•	•
FC4					•										•				•				•						
FC5																	•					•	•			•	•		
FC6	•				•	•	•		•										•										

Conventional designations: SKi – compulsory discipline, Bi – selective discipline, i – discipline number in the list of components of the educational component, INT – integral competence, GCj – general competence, FCj – professional (special) competence, j – competence number in the list of competences educational component.

5. Matrix of provision of programmatic learning outcomes with relevant components of the educational program

	SK1.1.	SK1.2.	SK1.3.	SK1.4.	SK1.5.	SK1.6.	SK2.1.	SK2.2.	SK2.3.	B1.1	B1.2.	B1.3.	B1.4.	B1.5.	B1.6.	B1.7.	B1.8.	B1.9.	B1.10.	B2.1.	B2.2.	B2.3.	B2.4.	B2.5.	B2.6.	B2.7.	B2.8.	B2.9.	B2.10.
Kn 1							•	•	•										•										
Kn 2	•				•		•	•	•			•					•			•	•	•	•	•	•	•			
Kn 3	•				•		•		•			•				•				•	•	•	•	•	•	•			
SK1	•				•	•	•	•	•			•							•			•	•			•	•			
SK2	•			•	•	•					•	•	•					•						•	•				
SK3		•	•			•				•				•					•										
SK4	•				•	•	•		•			•					•						•						
SK5	•				•	•	•		•			•								•	•	•	•	•	•	•			
SK6	•				•	•	•	•	•			•					•					•	•			•	•			
SK7	•			•	•	•					•	•	•																
SK8	•				•		•		•			•			•		•		•			•	•			•	•	•	
SK9		•	•			•				•				•					•										•
Com1		•	•			•				•				•															•
Com2		•	•			•				•				•			•												•
AiB1				•							•		•			•			•						•			•	
AiB2				•							•								•						•			•	
AiB3				•							•				•										•				

Conventional designations: SKi – mandatory discipline, Bi – selective discipline, i – number of the discipline in the list of components of the educational component, Knm – program results (knowledge), Skm – program results (skills), m – number of the program result in the list of program results educational component