

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

LVIV POLYTECHNIC NATIONAL UNIVERSITY

" APPROVED "

Rector of
National University
"Lviv Polytechnic"
_____ / Bobalo Yu.Ya. /
" ____ " _____ 2021

EDUCATIONAL AND SCIENTIFIC PROGRAM

third (educational and scientific) level of higher education

specialty 141. Electric power engineering, electrical engineering and electromechanics

branch of knowledge 14. Electrical engineering

qualification Doctor of Philosophy in the field of "Electrical Engineering" with a specialty in "Power Engineering, Electrical Engineering and Electromechanics"

Reviewed and approved
at the meeting of
Lviv Polytechnic National University
Academic Council
dated by " " 2021
Meeting protocol № _____

Lviv 2021

Developed by a working group in the specialty

141 Power engineering, electrical engineering and electromechanics

Head of the Working Group (guarantor):

Petro Stakhiv

– Doctor of Technical Sciences, Prof., Professor of the Department of Theoretical and General Electrical Engineering;

Members:

Andriy Lozynskyi

- Doctor of Technical Sciences, Professor, Director of Institute of Electric Power Engineering and Control Systems;

Vasyl Malyar

- Doctor of Technical Sciences, Professor of the Department of Theoretical and General Electrical Engineering;

Tkachuk Vasyl Ivanovych

- Doctor of Technical Sciences, Prof., Professor of Department of Electromechatronics and Computerized Electromechanical Systems;

Andriy Stepanovych Kutsyk

- Doctor of Technical Sciences, Prof., Professor of Department of Electromechatronics and Computerized Electromechanical Systems;

Mykhailo Seheda

- Doctor of Technical Sciences, Prof., Head of Department of Electric Power Engineering and Control Systems;

Yuriy Omelyanovych Varetskyi

- Doctor of Technical Sciences, Prof., Professor of Department of Electric Power Engineering and Control Systems;

Representatives of post graduate students:

Borovets Taras Vasyliovych

- graduate student of the Department of Electromechatronics and Computerized Electromechanical Systems;

Anastasia Vakarchuk

- graduate student of the Department of Electromechatronics and Computerized Electromechanical Systems;

Employer representatives:

Horbkovy Ihor Yosifovych

- director of the Zahidne regional enterprise SE "Siemens-Ukraine";

Fedak Taras Vasyliovych

- technical director of Eco-Optima LLC.

Guarantor

_____ DSc, Prof. P. Stakhiv

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).

Meeting Protokol No. ____ of _____ 2022

Head of the Academic Council of IPECS _____ Andrii Lozynskyi
(signature) (прізвище, ініціали)

Approved and brought into force

by the Order of Rector of Lviv Polytechnic National University

No. _____ of _____ 2022

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LETTER OF AGREEMENT

EDUCATIONAL AND SCIENTIFIC PROGRAMS

LEVEL OF HIGHER EDUCATION the third (educational and scientific)
BRANCH OF KNOWLEDGE 14 Electrical engineering
SPECIALTY 141 Power engineering, electrical engineering and electromechanics
QUALIFICATION Doctor of Philosophy

APPROVED

Scientific and methodical commission of the specialty 141 Electric power engineering, electrical engineering and electromechanics

Protocol No. _____
from " __ " _____ 2021

Head of the NMC of the specialty
141 Electric power engineering and electromechanics

_____ Malyar V.
" __ " _____ 2021

Director of the *Institute of Power Engineering and Control Systems*

_____ Lozynsky A..
" __ " _____ 2021

RECOMMENDED

Scientific and methodological council of the University

Protocol No. _____
from " __ " _____ 2021

Head of NMR

_____ A. Zahorodniy

AGREED

Head of the educational and methodical department

_____ Sviridov V.
" __ " _____ 2021

Vice-rector for scientific work

_____ Demydov I..
" __ " _____ 2021

Vice-rector for scientific and pedagogical work

_____ Davydchak O..
" __ " _____ 2021

I. EDUCATIONAL COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

1. DOCTOR OF PHILOSOPHY PROGRAM PROFILE FOR THE SPECIALTY "Electric power engineering, electrical engineering and electromechanics"

1 - General information	
Full name of the higher education institution and structural unit	Lviv Polytechnic National University
The full title of the qualification in the original language	Doctor of Philosophy in the specialty "Power Engineering, Electrical Engineering and Electromechanics" Doctor of Philosophy degree
The official title of the educational program	Electric power engineering, electrical engineering and electromechanics Electric Power Engineering, Electrical Engineering and Electromechanics
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 - 1.5 years
Availability of accreditation	Accredited by the National Agency for Quality Assurance of Higher Education
Cycle/level	NRK of Ukraine – 8th level, FQ-EHEA – third cycle, EQF-LLL – 8th level
Prerequisites	Master's level
Language(s) of instruction	Ukrainian language
Basic concepts and their definitions	The program uses basic concepts and their definitions according to the standard of higher education in the specialty "Electricity, electrical engineering and electromechanics"
2 - The purpose of the educational program	
	To provide theoretical knowledge and practical abilities and skills of conducting of the scientific research activities.
3 - Characteristics of the educational program	
Subject area (field of knowledge, specialty)	<i>Electrical engineering: electrical engineering, electrical engineering, electromechanics</i>
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	Acquiring the necessary research skills for a scientific career, teaching special disciplines in the field of power engineering, electrical engineering and electromechanics, as well as commercialization of the results of research activities and technology transfer. Keywords: electric power, electrotechnical and electromechanical complexes and systems, electromagnetic and electromechanical energy conversion, electrical engineering, electrical stations, autonomous electrical systems.
Features and differences	The scientific component of the educational and scientific program is determined by the individual study plan of the post graduate student

4 – Eligibility of graduates of the educational program to employment and further education	
Suitability for employment	Jobs in scientific research institutes of the National Academy of Sciences of Ukraine, universities of the Ministry of Education and Science of Ukraine, scientific centers and high-tech companies of the electrotechnical profile, enterprises of the energy sector.
Further education	Advanced training in research institutes of the National Academy of Sciences of Ukraine, leading universities and research centers of electric power and electrical engineering companies.
5 – Teaching and assessment	
Teaching and learning	Lectures, practical classes, research in laboratories, processing of publications in leading publications of the electrical engineering profile, consultations with teachers, writing abstracts, preparation of a dissertation.
Assessment	Written and oral exams, assessments, oral presentations.
6 – Program competencies	
Integral competence (IC)	The ability to solve complex problems in the field of electric power, electrical engineering and electromechanics, to carry out research and innovation activities, which involves a deep rethinking of existing and creation of new integral knowledge, as well as practical implementation of the obtained results.
General competences (GC)	<ol style="list-style-type: none"> 1) Knowledge of modern methods of conducting research in the field of electric power, electrical engineering and electromechanics and in related fields; 2) critical analysis, evaluation and synthesis of new ideas; 3) acquisition of language competences 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 scientific texts; skill to communicate effectively with the broad scientific community and the public on topical issues of electric power, electrical engineering and electromechanics. 4) ability to self-develop and self-improve during life, responsibility for teaching others, ability to organize and conduct training sessions 5) social responsibility for the results of strategic decision-making; 6) initiation of original research and innovation complex projects, 7) mastering general scientific (philosophical) competences aimed at the formation of a systematic scientific worldview, professional ethics and a general cultural outlook. 8) acquisition of universal researcher skills, in particular, organization and conduct of training sessions, use of modern information technologies (NMBD, Microsoft Teams, Zoom). 9) acquisition of universal skills of a researcher, in particular, oral and written presentation of the results of one's own research in Ukrainian, management of scientific projects and/or drafting proposals for financing scientific research, registration of intellectual property rights.
Special (professional)	1) Acquiring in-depth knowledge of the specialty in which the post

competences (SC)	<p>graduate students student conducts research, in particular, 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> <ol style="list-style-type: none"> 2) knowledge and understanding of modern scientific theories and methods, and the ability to effectively apply them for the synthesis and analysis of electric power, electrotechnical or electromechanical systems; 3) ability effectively apply methods of analysis, mathematical modeling, perform physical and mathematical experiments when conducting scientific research; 4) the ability to integrate knowledge from other disciplines, apply a systematic approach and take into account non-technical aspects when solving engineering problems and conducting research; 5) the ability to develop and implement projects, including own research, which provide an opportunity to rethink existing or create new knowledge; 6) the ability to argue the choice of a method of solving a specialized problem, critically evaluate the obtained results and defend the decisions made.
7 – Program learning outcomes	
Knowledge (Kn)	<ul style="list-style-type: none"> - the ability to demonstrate knowledgemodern research methodsin the field of power engineering, electrical engineering and electromechanics; -the ability to demonstrate in-depth knowledge in the chosen field of scientific research; - the ability to demonstrate an understanding of the impact of technical solutions in a public, economic and social context.
Skill (Sk)	<ul style="list-style-type: none"> - search, analyze and critically evaluate information from various sources; - apply knowledge and understanding to solve problems of synthesis and analysis of elements and systems characteristic of the chosen field of scientific research; - research and model phenomena and processes in complex dynamic electric power, electrotechnical and electromechanical systems; - apply a systematic approach, integrating knowledge from other disciplines and taking into account non-technical aspects, when solving theoretical and applied problems of the chosen field of scientific research; - combine theory and practice, as well as make decisions and develop a strategy for solving scientific and applied problems, taking into account universal human values, public, state and industrial interests; - work effectively both individually and as part of a team; - independently perform experimental studies and apply research skills; - evaluate the expediency and possibility of applying new methods and technologies in the tasks of synthesis of electric power, electrotechnical and electromechanical systems; - justify the choice of methods for solving a scientific and applied problem, critically evaluate the obtained results and defend the decisions made.
Communication (COM)	<ul style="list-style-type: none"> - the ability to communicate effectively at the professional and social levels;

	- the ability to present and discuss the obtained results and transfer the acquired knowledge;
Autonomy and responsibility (A&R)	- the ability to adapt to new conditions, make decisions independently and initiate original research and innovation complex projects; - the ability to realize the need for lifelong learning in order to deepen acquired and acquire new professional knowledge; - the ability to take responsibility for the work performed and achieve the set goal in compliance with the requirements of professional ethics.
8 – Resource support for program implementation	
Specific characteristics of personnel support	100% of the teaching staff involved in teaching professionally oriented disciplines have scientific degrees in their specialty
Specific characteristics of material and technical support	The use of modern equipment of leading electrical engineering companies, in particular ABB, Schneider Electric, Moeller, Siemens, Lenze.
Specific characteristics of informational and methodological support	The use of the virtual learning environment of Lviv Polytechnic National University and author's developments of the teaching staff.
9 – The main components of the educational program	
List of educational components (disciplines, practices, coursework and qualification papers)	The matrix of correspondence of program competencies to educational disciplines and the structure of the educational program are given in the Appendix
10 – Academic mobility (regulated by CMU Resolution No. 579 "On Approval of the Regulation on the Procedure for Realizing the Right to Academic Mobility" dated by August 12, 2015)	
National credit mobility	On the basis of bilateral contacts between Lviv Polytechnic National University and technical universities of Ukraine.
International credit mobility	Within the framework of the EU Erasmus+ program on a bilateral basis contacts between Lviv Polytechnic National University and educational institutions of partner countries
Education of foreign students of higher education	Possible.

2. DISTRIBUTION OF THE CONTENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM BY GROUPS OF COMPONENTS AND TRAINING CYCLES

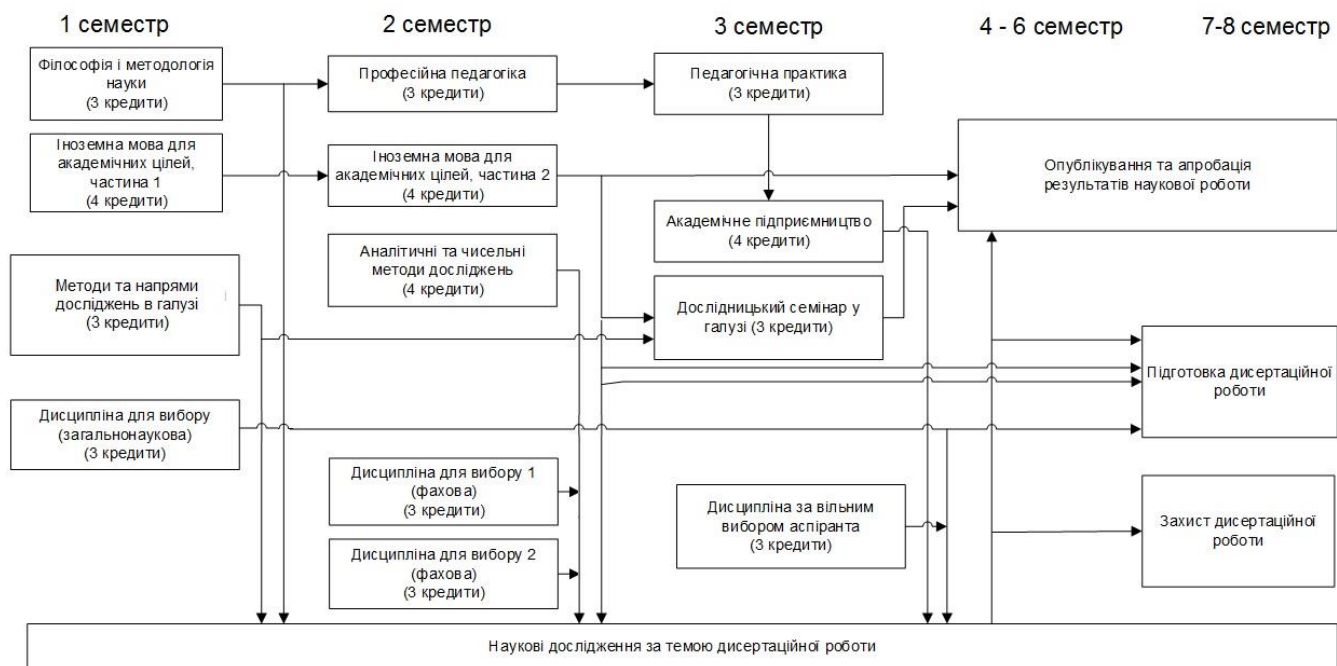
No	Training cycle	The volume of the educational load of the student of higher education (credits / %)		
		<i>Mandatory components of the educational component</i>	<i>Selective components of the educational component</i>	<i>Total for the entire period of study</i>
1.	Cycle of disciplines that form general scientific competences and universal skills of the researcher	<i>21 / 49</i>	<i>3 / 7</i>	<i>24 / 56</i>
2.	Cycle of disciplines forming professional competences	<i>10/23</i>	<i>6 / 14</i>	<i>16 / 37</i>
3.	Cycle of subjects of free choice of a post graduate students	-	<i>3 / 7</i>	<i>3/7</i>
Total for the entire period of study		<i>31/72</i>	<i>12 / 28</i>	<i>43 / 100</i>

3. LIST OF EDUCATIONAL AND SCIENTIFIC COMPONENTS

Code n/a	Components of the educational component	Number of credits	Form subs. counter.
1	2	3	4
1. Mandatory components of the educational component (Mandatory component- MC)			
<i>1.1. Cycle of disciplines that form general scientific competences and universal skills of the researcher</i>			
MC1.1.	Philosophy and methodology of science	3	exam
MC 1.2.	A foreign language for academic purposes, part 1	4	test
MC 1.3.	A foreign language for academic purposes, part 2	4	exam
MC 1.4.	Professional pedagogy	3	test
MC 1.5.	Academic entrepreneurship	4	test
MC 1.6.	Pedagogical practice	3	test
Total per cycle:		21	
<i>1.2. Cycle of disciplines forming professional competences</i>			
MC 2.1.	Analytical and numerical research methods	4	exam
MC 2.2.	Research seminar in the field of electric power engineering, electrical engineering and electromechanics	3	test
MC 2.3.	Methods and directions of research in the field of electric power engineering, electrical engineering and electromechanics	3	test
Total per cycle:		10	
2. Selective components of the educational component (SB – Selective Block)			
<i>2.1. Cycle of disciplines that form general scientific competences and universal skills of the researcher</i>			
SB1.1	Business Foreign Language	3	test
SB 1.2	Psychology of creativity and invention	3	test
SB 1.3	Management of scientific projects	3	test
SB 1.4	Technology of registration of grant applications and patent rights	3	test
SB 1.5	Rhetoric	3	test
SB 1.6	Presentation of the results of scientific research	3	test
SB 1.7	Open scientific practices	3	test
SB 1.8	Academic integrity and quality of education	3	test
SB 1.9	Modern inventions in research activities	3	test
SB 1.10	Methodology of preparation of scientific publications	3	test
Total per cycle:		3	
<i>2.2. Components of selective blocks of educational programs that form professional competences</i>			
SB 2.1	Modern control methods and their application in electrical engineering systems	3	exam
SB 2.2	System analysis and methods of identification of electrical engineering objects	3	exam
SB 2.3	Synthesis of modern controlled electromechanical converters	3	exam
SB 2.4	FEM analysis in problems of electromechanics	3	exam
SB 2.5	Macro modeling of components of electromechanical systems	3	exam
SB 2.6	Prediction of time characteristics of electric power systems and networks	3	exam
SB 2.7	Methods of analysis and management of intelligent electric power systems	3	exam
SB 2.8	Transient processes and overvoltages in electric power systems	3	exam
Total per cycle:		6	
3. Disciplines of the post graduate students 's free choice*			
SB 3.1	Discipline of the post graduate students 's free choice	3	test
Total per cycle:		3	
Total:		12	
TOGETHER		43	

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

Structural and logical scheme of the educational and scientific program



4. MATRIX OF CORRESPONDENCE OF SOFTWARE COMPETENCES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

	MC 1.1	MC 1.2	MC 1.3	MC 1.4	MC 1.5	MC 1.6	MC 2.1	MC 2.2	MC 2.3	SB1.1	SB1.2	SB1.3	SB1.4	SB 1.5	SB 1.6	SB 1.7	SB 1.8	SB 1.9	SB 1.10	
INT	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
GC 1							•	•												
GC 2								•	•		•	•							•	
GC 3		•	•							•			•	•	•	•	•	•	•	•
GC 4		•	•	•		•			•	•										
GC 5	•										•	•								
GC 6					•				•		•	•								
GC 7	•			•							•					•	•	•	•	•
GC 8						•	•	•	•											
GC 9												•	•	•	•	•	•	•	•	•
SC 1							•	•	•											
SC 2									•											
SC 3							•		•											
SC 4	•							•												
SC 5					•			•												
SC 6						•								•						

Legend:• – acquired competence; MC1.j – common components of the training program of the specialty; SB1.j – a discipline of the student's choice from the disciplines that form general scientific competences and universal skills of the researcher; SB2.j.1, SB2.j.2 – disciplines of the selective block that form professional competences; SB3.1 is a discipline of the student's free choice. GCi - competency number in the list of general competencies of the program profile; SCi is the competency number in the list of special competencies of the program profile.

5. MATRIX OF PROVIDING SOFTWARE LEARNING OUTCOMES BY RELEVANT COMPONENTS EDUCATIONAL PROGRAMS

	MC1.1	MC1.2	MC 1.3	MC 1.4	MC 1.5	MC 1.6	MC 2.1	MC 2.2	MC 2.3	SB1.1	SB 1.2	SB 1.3	SB 1.4	SB 1.5	SB 1.6	SB 1.7	SB 1.8	SB 1.9	SB 1.10
Kn 1							•											•	
Kn 2									•				•		•	•		•	
Kn 3	•				•						•	•				•			•
Sk 1							•				•	•	•		•			•	•
Sk 2									•									•	
Sk 3							•	•											
Sk 4	•				•											•			
Sk 5	•				•											•		•	
Sk 6					•											•			•
Sk 7							•	•										•	
Sk 8									•										
Sk 9							•					•		•	•				•
COM 1		•	•	•	•	•		•		•			•	•	•		•	•	
COM 2		•	•		•			•		•		•		•	•		•	•	
A&R 1					•							•					•		
A&R 2		•	•	•		•				•									
A&R 3				•	•	•					•	•	•				•		

Legend:• – program result that is provided; MC1.j – common components of the training program of the specialty; SB1.j – a discipline of the student's choice from the disciplines that form general scientific competences and universal skills of the researcher; SB2.j.1, BB2.j.2 – disciplines of the selective block that form professional competences; SB3.1 is a discipline of the student's free choice.

II. SCIENTIFIC COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

The scientific component of the educational-scientific program involves the post-graduate students 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 that offers a solution to the current scientific and applied task in the specialty 141 "Electric power, electrical engineering and electromechanics", the results of which are characterized by scientific novelty and practical value and are published in relevant publications.

Conducting scientific research by a post graduate students t 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 an individual plan of scientific work of a post graduate student and is an integral part of the postgraduate curriculum.

Preparation and publication of scientific papers, speeches at scientific conferences, scientific professional seminars, round tables, symposia are an integral part of the scientific component of the postgraduate educational and scientific program.

Areas of scientific research by specialty

141 "Electric power engineering, electrical engineering and electromechanics":

1. Management of technological processes and electromechanical systems in industry.
2. Mathematical modeling, automated design and development of electromechanical valve systems, electromechanical converters and their control systems.
3. Theoretical and experimental study of electric machines taking into account the non-linearity of electric circuits and electromagnetic connections.
4. Mathematical modeling and research of processes in electric circuits, systems, environments.
5. Mathematical modeling of electromagnetic processes in power systems and optimization of power stations and substations.
6. Modeling, analysis, synthesis and optimization of electric power facilities and active electric networks, their intelligent systems of control, protection, automation and state diagnostics.
7. Increasing the reliability, efficiency and electromagnetic compatibility of power supply systems.
8. Creation of intelligent design systems and automated control systems for power supply technological processes.
9. Resource-saving technologies and intelligent control systems in the power supply of objects of economic activity.

III. FORM OF CERTIFICATION OF HIGHER EDUCATION ACQUIRES

Attestation of higher education holders of the degree of Doctor of Philosophy in specialty 141 "Electroenergetics, electrical engineering and electromechanics" is carried out by a specialized academic council, formed for a one-time defense, on the basis of a public defense of scientific achievements in the form of a dissertation.

The minimum volume of the main text of the dissertation is 3.5 pages.

Attestation of higher education holders of the degree of Doctor of Philosophy in specialty 141 "Electroenergetics, electrical engineering and electromechanics" is carried out in accordance with the Provisional Regulation "On the organization of attestation of holders of higher education of the degree of Doctor of Philosophy at the Lviv Polytechnic National University.