

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

«APPROVE»

Rector

Lviv Polytechnic National University

_____ / Yurii Bobalo/
« _____ » _____ 2021

**EDUCATIONAL AND SCIENTIFIC PROGRAM
of third (educational and scientific) level of higher education
in specialty 193 "Geodesy and land management"
branch of knowledge 19 "Architecture and construction"**

Qualification: Doctor of Philosophy in Geodesy and Land Management

University

Considered and approved
Academic Council of the

(minutes № 74
of « 25 » 05 2021)

Lviv 2021

Developed by the working group in specialty 193 "Geodesy and land management" composed of:

Head of the working group (guarantor):

Dorozhynskyy O.L. - Dr. of technical science, professor, professor of the department of photogrammetry and geoinformatics

Members:

Trevoho I.S. - Dr. of technical science, professor, professor of the department of geodesy, deputy director for scientific and international activities

Hubar Yu.P. - Dr. of technical science, associate professor, head of the department of land cadastre

Hlotov V.M. - Dr. of technical science, professor, head of the department of photogrammetry and geoinformatics

Tserklevych A.L. - Dr. of technical science, professor, head of the department of engineering geodesy

Zablotskyy F.D. - Dr. of technical science, professor, head of the department of higher geodesy and astronomy

Sossa R.I. - Dr. of geographic science, associate professor, head of the department of cartography and geospatial modeling

Rishard Tukay - Dr. of philosophy, president of the board of Ltd Tukaj Mapping Central Europe (TMCE / Poland, Krakow)

Zayats I.M. - Ph.D., deputy director of the Research Institute of Geodesy and Cartography (Kyiv)

Kachmar O.J. - candidate of agricultural sciences, senior researcher (Lviv), head of Department of Agriculture and Soil Fertility of the Institute of Agriculture of the Carpathian Region of the National Academy of Sciences of Ukraine

Toropa I.M. - Ph.D., associate professor (Lviv), leading specialist of PE "Navigational and geodetic technologies"

Oliinyk M.A. - Student of III (educational and scientific) level of HE

Teslia O.V. - Student of II (master) level of HE, member of the collegium and professional bureau of students of institute of geodesy

Head of the working group
(guarantor)

dr., prof. Dorozhynskyy O.L.

Approved and put into effect by the Order of the Rector of Lviv Polytechnic National University of " _ " _____ 2021, No. _____.

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CONSENT LETTER

Of educational and scientific program

Level of higher education	the third (educational and scientific)
Branch of knowledge	19 «Architecture and construction»
Specialty	193 Geodesy and land management
Qualification	doctor of philosophy

APPROVED

Scientific and methodical commission
of specialty 193 Geodesy and land
management
Minutes № 4 (38)
of «16» February 2021

Head of SMC HMK of specialty 193
Geodesy and land management
_____ Protsyk M.T.
« _ » _____ 2021

Director of Institute of geodesy
_____ Tretyak K.R.
« _ » _____ 2021

RECOMMENDED

Scientific and methodological council of
the university
Minutes № _____
of « _ » _____ 2021
Head of SMC
_____ Zahorodniy A. H.

AGREED

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

Vice-rector for scientific work
_____ Demydov I.V.
« _ » _____ 2021

Vice-rector for scientific and
pedagogical work
_____ Davydchak O.R.
« _ » _____ 2021

I. EDUCATIONAL COMPONENT OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

1. Profile of the Doctor of Philosophy program in the specialty 193 *Geodesy and Land Management*

1 – General information	
1	2
Full name of the higher education institution and structural division	Lviv Polytechnic National University
The full title of the qualification in the original language	Доктор філософії з галузі «Архітектура та будівництво» за спеціальністю «Геодезія та землеустрій» Doctor of Philosophy in Architecture and Construction by Specialty of Geodesy and Land Management
The official name of the educational and scientific program	Геодезія та землеустрій Geodesy and Land Management
Type of diploma and scope of the educational program	Diploma of Doctor of Philosophy, single, 43 ECTS of the educational component of the educational and scientific program, the term of the educational component of the educational and scientific program is 2 years
Cycle/level	NQF of Ukraine – 8 level, FQ-EHEA – the third cycle, EQF-LLL – 8 level
Prerequisites	Level of higher education "Master"
Language(s) of teaching	Ukrainian language
Basic concepts and their definitions	The educational and scientific program uses basic 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 Scientific and Scientific and Technical Activities" dated 11.26.2015, No. 848-VIII with amendments and additions, the Procedure for the training of higher education applicants for the degree of Doctor of Philosophy and Doctor of Sciences in higher educational institutions (scientific institutions), approved by Resolution of the Cabinet of Ministers dated March 23, 2020 No. 261
2 – The aim of the educational and scientific program	
	To deepen theoretical knowledge and practical abilities and skills in the field of Architecture and construction, specializing in Geodesy and land management, to develop philosophical and linguistic competences, to form universal skills of a researcher, sufficient for conducting and successfully completing scientific research and further professional and scientific activities.

3 - Characteristics of the educational and scientific program	
Subject area (branch of knowledge, specialty)	Branch of knowledge 19 Architecture and construction, specialty 193 Geodesy and land management

Continuation of Table

1	2
Orientation of the educational and scientific program	The educational-scientific program is based on generally known provisions and results of modern scientific research in geodesy, cartography, land management and cadastre, land and real estate valuation, geoinformation systems and technologies, photogrammetry and remote sensing and orients to the further professional and scientific career. It is aimed at the development of the theoretical-methodological and methodological-applied base of geomatics with an accentuation of the latest technologies and trends in the development of topographic and cartographic activities, which deepens the professional scientific worldview and provides the basis for conducting scientific research and further professional and scientific activities.
The main focus of the educational and scientific program	The educational and scientific program provides special knowledge and professional training in the field of geodesy and land management. <i>Keywords:</i> geodetic, photogrammetric, geoinformation methods, technologies and systems; devices and equipment; cadastre, land management, methods of land and real estate evaluation, cartography, geomatics.
Program features	The educational and scientific program covers a wide range of modern innovative vectors for the development of the theory and practice of geodetic science (geomatics), which forms an updated theoretical and applied base for conducting scientific research.
4 – Eligibility of graduates of the educational and scientific program to employment and further education	
Suitability for employment	Jobs in public and private higher education institutions, scientific and research institutions as teachers and researchers, in enterprises and organizations of various types of activities and forms of ownership in managerial positions.
Further education	Implementation of the scientific program of the fourth (scientific) level of higher education, Doctor of Science.
5 – Teaching and evaluation	
Teaching and learning	A combination of lecture, laboratory and practical classes, a pedagogical workshop, consulting with a scientific supervisor, a scientific and pedagogical community with independent scientific and educational work.
Evaluation	Exams, credits, current control.
6 – Program competences	
Integral competence (INT)	The ability to produce innovative scientific ideas, to master the methodology of scientific and pedagogical activity, to solve complex problems in the process of innovative research and professional activity, to conduct original scientific research in the field of geodesy and land management at the international and national level.

General competences (GC)	<ol style="list-style-type: none"> 1. In-depth knowledge in the field of geodesy, photogrammetry, cadastre and land management, cartography and remote sensing. 2. To demonstrate commitment to and comprehension of the philosophical methodology of cognition, the key principles of professional ethics, the system of moral and cultural values and conduct in scientific research.
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Continuation of Table

1	2
	<ol style="list-style-type: none"> 3. The ability to initiate and conduct original scientific research, identify current scientific problems, search for and critically analyze information, produce innovative constructive ideas, and create non-standard approaches to solving complex and atypical tasks. 4. The ability to demonstrate oratory and rhetorical skills when presenting the results of scientific research, to conduct a professional scientific conversation and debate with the wider scientific community and the public in Ukrainian, to form scientific texts in written form, to organize and conduct training sessions, to use progressive information and communication tools. 5. The ability to present and discuss the obtained results of scientific research in a foreign language in oral and written form, to freely read and fully understand foreign scientific texts. 6. The ability to be purposeful and persistent, to self-improve throughout life, to be aware of social and moral responsibility for the obtained scientific results. 7. The ability to initiate, substantiate and manage actual scientific projects of an innovative nature, to independently conduct scientific research, to interact in a team and to show leadership skills in the implementation of scientific projects.
Special (professional) competences (PC)	<ol style="list-style-type: none"> 1. The ability to apply professional knowledge and practical skills to solve typical tasks of the specialty, as well as to choose technical means for their implementation; 2. The ability to use knowledge and skills to calculate an a priori assessment of accuracy and choose technologies for designing and performing applied professional tasks. 3. The ability to investigate the problem and determine limitations, including those caused by problems of sustainable development, environmental impact and life safety. 4. Application of professional terminology in oral and written forms in native or foreign languages. 5. The ability to program and master the skills of working with a computer to solve applied professional problems, to use modern GIS to solve the problems of the industry. 6. The ability to use and implement new technologies, to participate in the modernization and reconstruction of equipment, devices, systems and complexes, in particular with the aim of increasing their efficiency and accuracy.

	7. The ability to interpret the results of own experiments and participate in scientific discussions with experienced scientists in the field, regarding the scientific and practical significance of the obtained results.
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Continuation of Table

1	2
7 – Program learning outcomes	
Knowledge (KN)	<ol style="list-style-type: none"> 1. Ability to demonstrate in-depth knowledge of national and foreign scientific achievements and theoretical and applied foundations in at least one of the fields of geodesy and land management: geodesy; cartography; land and cadastre; land and real estate valuation; geoinformation systems and technologies; photogrammetry and remote sensing. 2. Ability to demonstrate knowledge of the latest technologies, formulate and refine an important research problem, to solve it to gather the necessary information and formulate conclusions that can be protected in a scientific context. 3. Ability to demonstrate an understanding of the impact of technical solutions in social, social, environmental, economic contexts and project management. 4. Ability to work effectively in teams to retrieve, localize, and process data to solve a research problem and take responsibility for organizing work. 5. Ability to demonstrate knowledge and comprehensions of philosophical methodology of scientific knowledge, psychological and pedagogical aspects of professional-scientific activity, own scientific outlook and moral and cultural values. 6. Ability to demonstrate sufficient knowledge of a foreign language necessary for the oral and written presentation of the results of scientific research, conducting a professional scientific dialogue, full understanding of foreign scientific texts.

Skills (SK)	<ol style="list-style-type: none"> 1. Combine theory and practice, as well as make decisions and develop an activity strategy for solving specialty (specialization) tasks taking into account human values, public, state and industrial interests. 2. To apply knowledge from various subject areas of geomatics to formulate and justify new theoretical propositions and practical recommendations in a particular field of research. 3. To integrate and apply their knowledge on various interdisciplinary areas in the process of solving theoretical and applied problems in a particular area of study. 4. To choose and apply the methodology and tools of scientific research in carrying out theoretical and empirical studies in the field of geodesy and land management. 5. To carry out scientific researches and carry out scientific projects on the basis of actual scientific problems, definition of goals and tasks, formation and critical analysis of information base, substantiation and commercialization of research results, formulation of author's conclusions and proposals. 6. To perform mathematical and statistical modeling and socio-economic diagnostics of various processes and objects in the field of geomatics. 7. Conduct scientific discussion and discussion in Ukrainian and foreign language at the appropriate professional level, present the results of scientific research in oral and written form, organize and carry out pedagogical work.
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Continuation of Table

1	2
Communication (COM)	<ol style="list-style-type: none"> 1. Ability to communicate in business scientific and professional language, to apply different styles of speech, methods and techniques of communication, to demonstrate a wide scientific and professional vocabulary. 2. Ability to apply modern information and communication tools and technologies to ensure effective scientific and professional communications.
Autonomy and responsibility (A&R)	<ol style="list-style-type: none"> 1. Ability to independently conduct research and make decisions. 2. Ability to formulate own author's conclusions, suggestions and recommendations. 3. Ability to be aware of and to be personally responsible for the results of the research. 4. Ability to prepare and successfully defend a doctoral thesis based on own researches
8 – Resource support for the implementation of the educational program	
Specific characteristics of staffing	100% of scientific and pedagogical workers involved in teaching a cycle of disciplines that provide special (professional) competencies of a graduate student have scientific degrees and academic titles
Specific characteristics of material and technical support	<p>Use of modern geodetic, navigational, photogrammetric equipment of leading companies (manufacturers), in particular SPC "Geosistema", FARO, Leica, Topcon, Trimble; remote sensing data of space imaging systems of various types.</p> <p>Use of specialized software: ErdasImagine, ArcGIS, MapInfo, GIS "Panorama", Microstation, DPS Delta, Digitals, AutoCAD, Matlab, Photomod, AdobeIllustrator, Golden Software Surfer, GeoniCS RGS, a set of</p>

	software products CREDO, TrimbleBusinessCenter, LeicaGeoOffice, TopconTools, AutoCADCivil
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 scientific and pedagogical staff
9 – Academic mobility	
National credit mobility	On the basis of bilateral agreements between Lviv Polytechnic National University and universities of Ukraine
International credit mobility	As part of the EU Erasmus+ program on the basis of bilateral agreements between Lviv Polytechnic National University and educational institutions of partner countries
Education of foreign graduate students	Possible

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

№	Training cycles	The scope of the graduate student's educational load (credits / %)		
		Obligatory components of the educational constituent	Selective components of the educational constituent	Total for the entire period of study
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 that form professional competences	10/23	6/14	16/37
3.	Cycle of disciplines of free choice of post graduate student	-	3/7	3/7
Total for the entire period of study		31/72	12/28	43/100

3. Structure of the educational constituent of the educational and scientific program

Code e/d	Component of the educational constituent	Number of credits	Final control form
1	2	3	4
Obligatory components (OC) of the educational constituent			
<i>Cycle of disciplines that form general scientific competences and universal skills of the researcher</i>			
OC1.1.	Philosophy and methodology of science	3	exam
OC1.2.	Foreign language for academic purposes, part 1	4	credit
OC1.3.	Foreign language for academic purposes, part 2	4	exam
OC1.4.	Professional pedagogy	3	credit
OC1.5.	Academic entrepreneurship	4	credit
OC1.6	Teaching practice	3	credit
Total for the cycle:		21	
<i>Cycle of disciplines that form professional competences</i>			
OC2.1.*	Modern methods and technologies of geodesy and land management	4	exam
OC2.2.*	Research seminar in the field of geodesy and land management	3	credit
OC2.3.	Research methods in geodesy and land management	3	credit
Total for the cycle:		10 (3+3+4)	
Selective components (SC) of the educational constituent			
<i>Cycle of disciplines that form general scientific competences and universal skills of the researcher</i>			
SC1.1	Business foreign language	3	credit
SC1.2	Psychology of creativity and invention	3	credit
SC1.3	Management of scientific projects	3	credit
SC1.4	Technology of processing grant applications and patents	3	credit
SC1.5	Rhetoric	3	credit
SC1.6	Modern inventical management in scientific and research activities	3	credit
SC1.7	Open science practices	3	credit
SC1.8	Academic integrity and education quality	3	credit
SC1.9	Methodology of scientific paper publishing	3	credit
SC1.10	Quality of higher education (internal quality assurance systems)	3	credit
Total for the cycle:		3	

Continuation of Table

1	2	3	4
<i>Cycle of disciplines that form professional competences **</i>			
SC2.1	Modern Technologies of Cartographic Units Production Сучасні технології створення картографічної продукції	3	exam
SC2.2	Photogrammetry and Remote sensing in Environmental Monitoring	3	exam
SC2.3	World Cadastral Systems	3	exam
SC2.4	Positioning and Navigation Systems in Geodesy	3	exam
SC2.5	Digital Photogrammetry in Engineering	3	exam
SC2.6	Methodology of Real Estate Registration	3	exam
SC2.7	Engineering Geodynamics	3	exam
SC2.8	Metrological Research and Geodetic Instruments Testing	3	exam
SC2.9	Specific Issues of Theoretical Geodesy	3	exam
SC2.10	Local Geodetic Networks Establishment	3	exam
Total for the cycle:		6 (3+3)	
Disciplines of free choice of post graduate student ***			
SC3.1	Discipline of free choice of post graduate student	3	credit
Total for the cycle:		3	
TOTAL		43	

Note:

* - the list of disciplines that form professional competences are offered jointly for the ESPs of related branches and specialties;

** - the list of selective disciplines that form professional competences must contain ten disciplines, from which the post graduate student chooses two;

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

II. The scientific constituent of the educational and scientific program

The scientific constituent of the educational-scientific program involves the post-graduate student conducting his own scientific research under the guidance of one or two academic supervisors and the preparation of its results in the form of a thesis.

The thesis for obtaining the degree of Doctor of Philosophy is an independent detailed research that offers a solution to an actual scientific task in the specialty 193 Geodesy and land management, the results of which are an original contribution to the sum of knowledge in the specialty 193 Geodesy and land management and are published in relevant publications.

The scientific constituent 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 constituent of the postgraduate educational and scientific program is the preparation and publication of scientific papers, speeches at scientific conferences, scientific professional seminars, round tables, and symposia.

Topics of scientific research in specialty 193 *Geodesy and land management*:

1. Methods of photogrammetry and remote sensing in the study of the consequences of emergency situations.
2. Methods of photogrammetry and remote sensing in the organization of monitoring the development of dangerous natural and anthropogenic processes.
3. Development of the theory of evaluation of qualitative characteristics of composed aerospace images.
4. Formation of systems for aerospace monitoring of riverbed processes.
5. Research of methods of radiometric correction of aerospace images.
6. Research of methods of geometric correction of aerospace images.
7. Study of transmission characteristics of modern space imaging systems.
8. Development of large-scale mapping methods using UAVs.
9. Development of calibration methods for optical and optical-electronic imaging systems.
10. Research of short-baseline photogrammetry methods for documenting the historical and cultural environment.
11. Research of modern methods of geodetic measurements, improvement of their accuracy and conditions of their implementation and processing.
12. Study of methods of determining and taking into account vertical refraction on the accuracy of geodetic measurements.
13. Research and improvement of means and methods of metrological support of modern geodetic devices in Ukraine.
14. Development and research of methods of geodetic control of installation of large equipment.

15. Study of spatial deformations of pressure pipelines located in the field of geodynamic loads.
16. Research of horizontal deformations of the earth's crust at the Carpathian geodynamic site.
17. Optimizing the construction of geodetic networks by satellite radio navigation technologies.
18. Research of remote methods of determining the average integral temperature of the air in the path of an electromagnetic wave.
19. Complex geodetic observations of the stability of reference networks of the HPP and NPP.
20. Study of a high-resolution model of the Earth's gravity field based on satellite gradientometry data.
21. Study of the interaction model of seismicity and crustal deformation.
22. Monitoring of water fund lands.
23. Formation of land use investment factors.
24. Management of territories within settlements.
25. Methodological studies in the geoinformation system of the urban cadastre.
26. Organizational, legal and technical provision of lands for various purposes.
27. Institutional support of the cadastre information base.
28. Formation of investment climate in land relations.
29. System of market relations.
30. Information provision of cadastre and land management.
31. Optimization of cadastre works.
32. Measurement and modeling of Earth deformation rates.
33. Calculation of the quasi-geoid from ground and satellite data.
34. Study of ocean topography based on satellite altimetry data.
35. Construction of dynamic geodetic datums.
36. Analysis of distance measurement accuracy using GNSS technology.
37. Monitoring of geospatial data.
38. Designing a system of conventional signs.
39. Research, systematization, normalization and preservation of toponyms.
40. Forecasting the development of territories by methods of geoinformation modeling.
41. Mathematical and cartographic modeling.
42. Methods of automated generalization.
43. Cartographic research method.
44. Theory of cartographic projections.
45. Management of territorially distributed objects.
46. Infrastructure of geospatial data.
47. Geoinformation mapping technologies.
48. Development of automated systems for geodetic monitoring of industrial engineering structures.
49. Modeling the effects of the external environment on the results of satellite and ground geodetic measurements.
50. Improvement of the reference base for control of geometric parameters.

51. Research of modern spatial movements of the Earth's surface based on the results of GNSS observations.
52. Research and modeling of siltation processes of hydroelectric power and hydroelectric power stations reservoirs.
53. Study of the parameters of erosion processes and dynamics of the valley-channel topography of the Carpathian region.
54. Determination of the optimal parameters of GNSS observations for the creation and reconnaissance of DGM and special engineering networks.
55. Mathematical modeling of deformation processes based on the results of geodetic observations on geodynamic polygons.
56. Study of modern geodynamics of the Ukrainian Carpathians.
57. Use of UAVs for environmental monitoring of water bodies.
58. Application of modern geodetic technologies for the study of dynamic processes at potentially dangerous environmental objects.
59. Application of UAV and GNSS technologies for surveying and profiling road infrastructure objects.
60. Development of a methodology for performing engineering and geodetic works using satellite methods.
61. Modern methods of geodetic support of engineering works.

III. Certification of graduate students

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. The volume of the main text of the thesis of applicants for higher education with the degree of doctor of philosophy in specialty 193 "Geodesy and Land Management" should be 4.0 - 5.0 author's sheets.

The successful completion of individual study plan by the graduate student is a mandatory condition for admission to the defense.

The thesis must be completed in compliance with all requirements for academic integrity, which are regulated by the Regulations on academic integrity at the "Lviv Polytechnic National University" dated September 8, 2017, the Standard of Higher Education **SVO LP (або якщо перекласти SHE LP)** 03.14. "Regulations for checking for academic plagiarism of students' qualification works, manuscripts of dissertations and monographs, manuscripts of articles submitted for publication in periodical scientific publications, at the university" dated January 23, 2019, Procedure for checking the fact of publication of monographs, study guides, articles of academic title holders at the university and scientific degrees of doctor and candidate of sciences, as well as the statuses of publications in which these articles were published. The requirements regarding the procedure and special conditions for conducting a public defense are determined by the normative document of the Cabinet of Ministers of Ukraine in force at the time of the defense of the thesis.

Applicants for higher education for the degree of Doctor of Philosophy defend their thesis's, as a rule, in a permanent specialized academic council for the relevant specialty, which functions in the higher educational institution where the post graduate student was trained. The academic council of a higher educational institution has the right to submit documents to the National Agency for Quality Assurance of Higher Education 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 .

