Ministry of Education and Science of Ukraine
V.N. Karazin Kharkiv National University

Educational and Scientific Program
(освітньо-професійна / освітньо-наукова)

Pure Mathematics (the English language of instruction)
(назва програми)

second (master's) level of higher education
(перший (бакалаврський), другий (магістерський), третій (освітньо-науковий)

Field of knowledge E Natural Sciences, Mathematics and Statistics
(код, назва галузі)

Major E7 Mathematics
(шифр, назва спеціальності)

Specialization (in the presence) _____
(назва спеціалізації (спеціалізацій)

APPROVED by
The Academic Council
V.N. Karazin Kharkiv National University
"17" 03 of 2025,
protocol № 8

Effected from the 2025/2026 school year
by order 0114-1/142.2025 № 18.03.2025 р.

Vice-rector for scientific and pedagogical work
_____ Oleksandr HOLOVKO

Kharkiv 2025

APPROVAL

The educational and scientific program Pure Mathematics of the second (master's) level of higher education was reviewed and approved at by:

1. Scientific and Methodological Council of V.N. Karazin Kharkiv National University

14.03.2025 № 7

Chairman of the Scientific and Methodological Council,
Vice-Rector for Scientific and Pedagogical Studies

_____ Oleksandr HOLOVKO

2. Academic Council of the Faculty of Mathematics and Informatics: __10.03.2025 __ No.__4__

Head of the Academic Council of the faculty

_____ Hryhoriy Zholtkevych

3. Scientific and methodological commission of the Faculty of Mathematics and Informatics: 10.02.25 No. 7

Head of the scientific and methodical commission Faculty

_____ Ievgen MENIAILOV

4. Departments of Fundamental Mathematics: _07.02.2025 _ No. __10___

Acting as Head of the Department
candidate of physical and mathematical sciences,
Associate Professor

_____ Sergiy GEFTER

PREFACE

The educational and scientific program was developed by a working group consisting of:

Head of the working group (guarantor of the educational program)	
Fastovska Tamara Borysivna	Associate Professor of the Department of Fundamental Mathematics, Faculty of Mathematics and Informatics, Kharkiv National University named after V.N. Karazin, candidate of physical and mathematical sciences, associate professor
Members of the working group:	
Yampolskyi Oleksandr Leonidovych	Professor of the Department of Fundamental Mathematics, Faculty of Mathematics and Informatics, Kharkiv National University named after V.N. Karazin, doctor of physical and mathematical sciences, professor
Ignatovich Svitlana Yuriivna	Professor of the Department of Applied Mathematics, Faculty of Mathematics and Informatics, Kharkiv National University named after V.N. Karazin, doctor of physical and mathematical sciences, associate professor

The Program was developed with participatiobn of:
Representatives of the students community: Roman Skurihin, student of educational program "Philosophy Doctor", Ivan GOLUBEV, student of educational program "Master".
Representatives of stakeholder: Dmitry SHEPELSKY, Doctor of Sciences, Head of department of Differential Equation and Geometry of the B. Verkin Institute of Low Temperatures Physics and Egrneering of the National Academy of Sciences of Ukraine.

When developing the project of the Program, the following requirements were taken into account: the National Qualifications Framework of Ukraine for the 7th qualification level - master's degree.https://zakon.rada.gov.ua/laws/show/1341-2011-%D0%BF#Text, temporary standard of higher education of the Kharkiv National University named after V.N. Karazin, approved by the Academic Council of the University "__27__" 06___2022, minuet No._10_, which was put into effect by the rector's order № 0208-1/262 of

«__06__» _07_ 2022.

1.Profile of the educational program in the specialty E7 Mathematics

(the English language of instruction)

1 - General information	
Full name of the higher educational institution and structural division	V.N. Karazin Kharkiv National University, Faculty of Mathematics and Informatics
Official name educational program	Fundamental mathematics (English language of instruction). Educational and scientific program «**Pure mathematics" (the English language of instruction)**
Degree of higher education and the name of the qualification in the original language	Master's degree in mathematics
Type of diploma and scope of the educational program	Master's degree, single, 120 ECTS credits, study period 1 year 9 months
Availability of accreditation	Ministry of Education and Science of Ukraine, certificate of accreditation of specialty 111 Mathematics at the master's level № НД 2189565 until 01.07.2026.
Prerequisites	Having a bachelor's degree or Master's degree
Language(s) of instruction	English
The term of validity of the educational program	until 31.05.2027
Internet address of the permanent site of the educational program	https://math.karazin.ua/?page_id=900
2 - The purpose of the educational program	
Formation and development of general and professional competences in mathematics, which contribute to the social stability and mobility of the graduate in the labor market; obtaining a higher professional education, which will allow the graduate to successfully perform the functions and typical tasks of a mathematician in various fields of human activity, national economy and production, conduct research and obtain new scientific results	
3 – Characteristics of the educational program	
Subject area (field of knowledge, specialty)	E Natural Science, Mathematics and statistics, E7 Mathematics
Orientation of the	Educational and scientific, academic. Provides mastery of

educational program	a complex of general and professional competencies necessary for specialists to perform professional tasks and duties in the field of mathematics, in particular, fundamental mathematical training, the basics of skills for performing fundamental research in mathematics and its application in other sciences.
The main focus of the educational program and (specializations)	Special education in the field of mathematics, which includes thorough mathematical training, familiarization with the practice of independent scientific work in mathematics and the application of mathematical theories in fundamental research. *Keywords:*Mathematics, fundamental research
Features of the program	Thorough mathematical training with a focus on independent scientific research, development of mathematical theories and their application in various fields of science, education and various subject areas.
4 – Suitability of graduates for employment and further education	
Suitability for employment	Types of economic activity (according to DK 009:2010): 72.1 Scientific research and development 72.1 Research and experimental developments in the field of natural and technical sciences 72.19 Research and experimental developments in the field of other natural and technical sciences 85.32 Vocational and technical education 85.41 Vocational preliminary higher education 85.42 Higher Education *Possibilities of professional certification* Professional job titles (according to DK 003:2010): 2121.1 Research staff (mathematics) 2121.2 Mathematics
Further education	Continuation of studies at the next level of higher education to obtain the degree of Doctor of Philosophy in a compatible specialty. Obtaining additional qualifications in the postgraduate education system.
5 – Teaching and assessment	
Teaching and training	The main approaches to learning are competence-based, active, student-centered, and problem-oriented. The

	leading methods of learning are problem-based, partially research-based and research-based. Teaching and learning is conducted in the form of lectures, including interactive and multimedia lectures, practical classes, laboratory work, independent study, course research. Design, graphic educational modeling and interactive and communicative learning technologies are used	
Assessment	Four-level and two-level, 100-point evaluation system through the following types of control with the accumulation of points received: current (oral and written survey) control, intermediate (defense of practical, independent works), final (written exams, credit works, defense of practical reports), self-control, attestation (preparation and public defense of a master's thesis).	
6 – Program competencies		
Integral competence	The ability to solve complex mathematical problems and practical problems in professional activities or in the learning process, which involves conducting research and/or implementing innovations and is characterized by complexity and/or uncertainty of conditions.	
General competences (GC)	GC -01	Ability to abstract thinking, analysis and synthesis
	GC -02	Ability to apply knowledge in practical situations
	GC -03	Knowledge and understanding of the subject area and understanding of professional activity
	GC -04	Ability to conduct research at an appropriate level
	GC -05	Ability to learn and master modern knowledge
	GC -06	Ability to search, process and analyze information from various sources
	GC -07	Ability to work in a team
	GC -08	Ability to generate new ideas (creativity).
	GC -09	Ability to develop and manage projects
Professional Compenences (PC)	PC -01	Knowledge and understanding of fundamentals methods and applications of algebra, mathematical logic, category theory; ideas about

		the axiomatic construction of mathematical theories
	PC -02	The ability to formulate and prove mathematical statements, obtain conclusions, establish the correctness of solving problems and reasoning
	PC -03	Knowledge and understanding of fundamental methods of mathematical, complex and functional analysis, geometry, topology, etc. and the ability to use them in theoretical research and solving specific applied problems
	PC -04	Understanding of applied problems that can be investigated using modern mathematical methods, knowledge and understanding of methods of construction and qualitative and quantitative analysis of mathematical models of natural, man-made, economic and social objects and processes
	PC -05	The ability to use existing software tools to perform calculations, search for information, design work results, etc
	PC -06	The ability to choose an adequate mathematical apparatus, to use known theoretical concepts and facts to solve specific research problems
	PC -07	The ability to teach, present and formalize the obtained results, in particular, in the form of scientific articles and reports at scientific conferences
	PC -08	The ability to put forward, formulate and prove new theoretical statements and explore the possibilities of their application to solve specific theoretical and applied problems
	PC -09	The ability to conduct scientific research, set and solve new theoretical and applied problems, develop new innovative methods of solving and analyzing results
	PC -10	The ability to navigate new scientific directions in the field of mathematics, the latest developments and achievements.
7 – Program learning outcomes		
	PO.01	To know the classification and essence of

		modern global problems, the main directions of their solution, their reflection on the Ukrainian reality. To be able to apply this knowledge and methodologies in the study of modern political, economic and social processes in the world and in Ukraine.
	PO.02	To know the main types of linear differential equations with partial derivatives, methods of researching solutions. Be able to apply these methods to the study of general elliptic, parabolic and hyperbolic equations of the second order, including equations arising in physical models, use methods of constructing approximate solutions
	PO.03	Know the definitions, examples and basic properties of groups, rings, fields, modules and linear spaces, their (homo)morphisms, categories and functors. To be able to apply these concepts and methods for the study of algebraic objects in problems from various branches of mathematics and its applications.
	PO.04	Know the basic concepts and theorems of differential topology related to smooth manifolds and mappings, tangent spaces, forms and integration, basic concepts of Riemannian and metric geometry. Be able to study smooth manifolds and geometric structures on them and use them in theoretical and practical problems.
	PO.05	Know the theorems and methods of modern sections of functional and complex analysis, in particular the basic facts about Banach and Hilbert spaces and operators in them, elements of the spectral theory of operators, the theory of Fourier series in Hilbert space and basic facts about the Fourier transform, properties of holomorphic functions, zeros of entire functions, conformal equivalence of domains, basic theorems of complex analysis. To be able to explore spaces and operators by methods of functional analysis, different classes of functions by methods of complex analysis

	PO.06	To know the statements of the main problems of modern control theory, the main research methods of linear and some nonlinear controlled systems, the formulation of the Pontryagin maximum principle, the methods of solving the synthesis problem for linear systems based on the controllability function method. To be able to apply these methods, build mathematical models and investigate them for the simplest applied problems of control theory
	PO.07	To demonstrate the ability to self-study, to be able to organize one's own activities and safe working conditions
	PO.08	Demonstrate communication skills with other people, the ability to present research results in the form of a speech at a scientific seminar, the ability to work in a team
	PO.09	Be able to use existing knowledge in mathematics and other areas of knowledge, research sources (including in foreign languages), systematize and process the information received, make reviews and teach at a seminar, use known information to obtain new results, build examples, prove new theorems based on existing or for the construction and research of new mathematical models of objects and processes of the real world. Be able to present research results in the form of a completed work, present and defend its content
	PO.10	To be able to apply existing knowledge of mathematical theories for setting new problems, proposing hypotheses, formulating and proving new mathematical results and their analysis
	PO.11	To be able to organize one's work and the work of a team of performers when conducting scientific research or implementing a practical project
	PO.12	Be able to carry out a scientific and technical

		search in modern sources of information, analyze and correlate results from various sources, navigate in the latest scientific directions and their applications
8 – Resource support for program implementation		
Specific characteristics of personnel support	Complies with license terms. All teachers are full-time teachers of KhNU named after V.N. Karazin, have a scientific degree and/or academic title corresponding to the main profile of the taught discipline. All teachers undergo advanced training every five years.	
Specific characteristics of material and technical support	Equipment and equipment, technical teaching aids (boards-screens; multimedia projectors, laptops, printers, scanners, personal computers with software) for the formation of subject competencies in the process of training the applicant. There are classrooms, laboratories, computer classes, a dormitory, food outlets, wireless Internet access points, gyms, etc.	
Specific characteristics of information and educational and methodological support	The official site of KhNU named after V.N. Karazin, unlimited access to the Internet, printed (funds of the National Central Bank named after V.N. Karazin, repository, own libraries of educational laboratories, cartographic works) and Internet sources (including the Center for Electronic Learning of the KhNU) information; study and work plans (with explanatory notes to them), educational programs, work programs of disciplines and practices, educational and methodological complexes of disciplines, including lecture material, tasks of practical work, questions of seminar classes, tasks of independent work, questions, problems, tasks for current and final control. Complies with license terms, 100%	
9 – Academic mobility		
National credit mobility	Faculty of Mathematics and Informatics of Kharkiv National University named after V.N. Karazina, which includes the Department of Fundamental Mathematics, is a partner member of the Erasmus+ Program and participates in academic mobility projects.	

International credit mobility	Faculty of Mathematics and Informatics of Kharkiv National University named after V.N. Karazina, which includes the Department of Fundamental Mathematics, is a partner member of the InterMaths Consortium - the International Joint Master's Program in the Field of "Applied and Interdisciplinary Mathematics", which was created • UAQ - University of L'Aquila (Italy) • BUT - Brno University of Technology (Czech Republic) • US - University of Silesia in Katowice (Poland) • LNU - Lviv Ivan Franko National University (Ukraine)
Education of foreign students of higher education	Citizens of other countries are admitted to study on the basis of international agreements on the terms defined by these agreements, as well as agreements concluded by the educational institution with foreign educational institutions, organizations, or individual agreements, contracts.

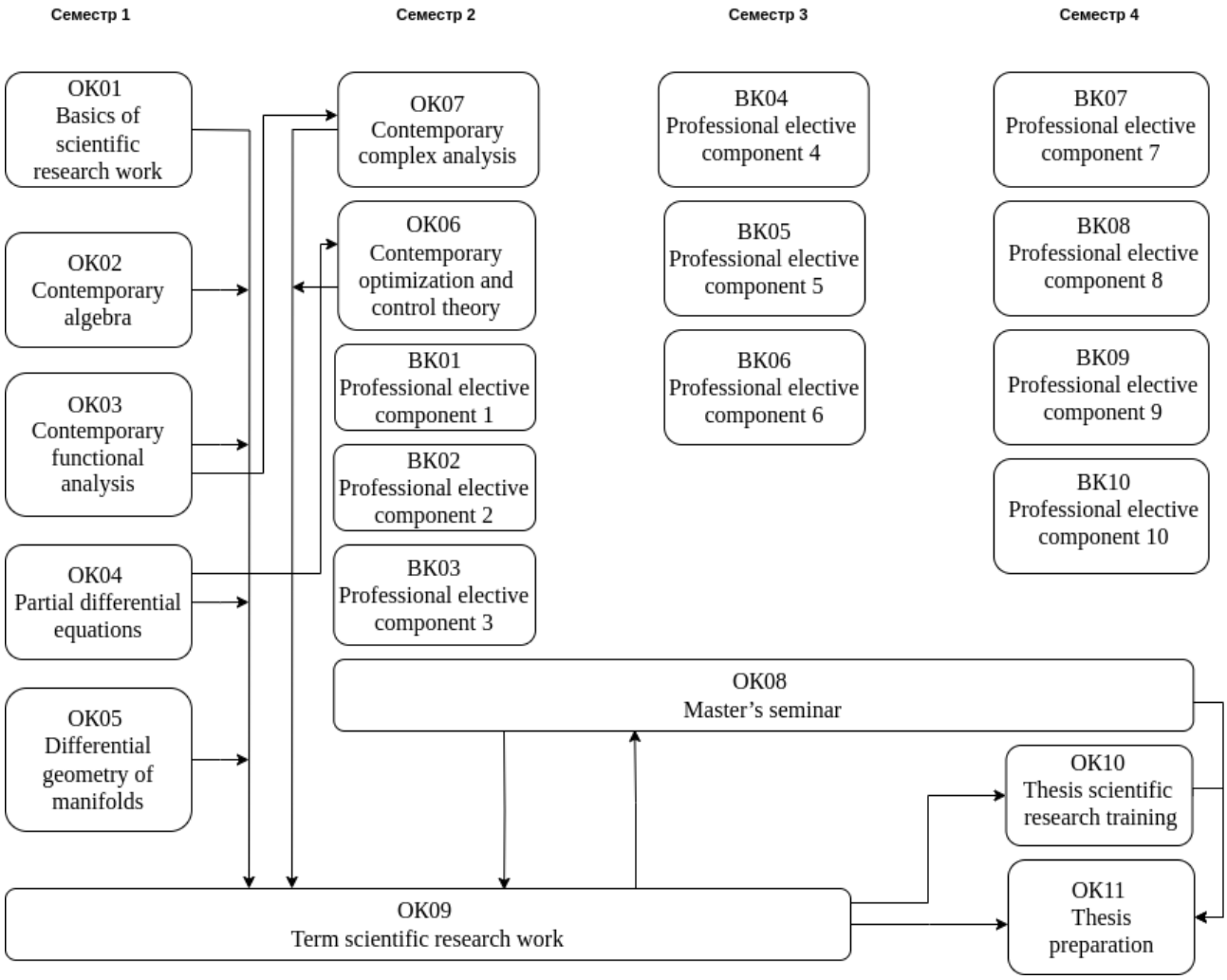
2. List of components of the educational and professional program and their logical sequence

Code of academic discipline	Components of the educational program (study subjects, course projects (works), practices, qualification work)	Number of credits	Grading
1	2	3	4
I. Mandatory components			
OK01	Basics of scientific research work	3	test
OK02	Contemporary algebra	6	examination
OK03	Contemporary functional analysis	6	examination
OK04	Differential geometry of manifolds	6	examination
OK05	Partial differential equations	6	examination
OK06	Contemporary optimization and control theory	4	examination
OK07	Contemporary complex analysis	3	examination
	Research part		
OK08	Master's seminar	5+6+3=14	Test (3)
OK09	Term scientific research work	3+3+3=9	Test (3)
OK10	Thesis scientific research training	9	test
OK11	Thesis preparation	6	examination

The total amount of mandatory components		72 credits	
II. Elective component *10 disciplines are chosen according to the catalog of professional optional disciplines of the Department of Pure Mathematics (http://puremath.univer.kharkov.ua/MagONP120-eng.html) total of 48 ECTS credit*			
BK01	Elective 1	6	test
BK02	Elective 2	6	test
BK03	Elective 3	6	test
BK04	Elective 4	6	test
BK05	Elective 5	6	test
BK06	Elective 6	6	test
BK07	Elective 7	3	test
BK08	Elective 8	3	test
BK09	Elective 9	3	test
BK10	Elective 10	3	test
The total amount of elective OP components		**48**	
TOTAL		**120**	

According to the Law of Ukraine "On Higher Education", students have the right to "choose academic disciplines within the limits provided by the relevant educational program and work curriculum, in the amount of at least 25 percent of the total number of ECTS credits provided for a given level of higher education At the same time, students of a certain level of higher education have the right to choose academic disciplines offered for other levels of higher education by the head of the corresponding faculty or unit."

3. Structural and logical scheme of PO



4.Form of attestation of applicants of higher education

Attestation of higher education applicants in a specialty is carried out in the form of defense of a master's qualification thesis. Attestation is carried out by the Examination Commission, which was approved by order of the rector of V.N. Kharkiv National University. Karazin. The examination board makes a decision on awarding the graduate student with the qualification of master of mathematics and issues a state diploma. This diploma is a legal document that allows a specialist to occupy primary positions in accordance with their list and the corresponding nomenclature of positions in force in Ukraine. Students who have fully met the requirements of the curriculum are admitted to attestation.

The master's qualification work is a completed scientific research, it must have

internal unity and testify to the readiness of the applicant to perform professional duties using the acquired integrated knowledge, skills and practical skills. The qualification work involves the analysis and applied research of problems in the field of mathematics. The scope and structure of the work is established by the higher educational institution. The work is checked for the presence of academic plagiarism according to the procedure defined by the system of ensuring the quality of educational activities and the quality of higher education by the higher educational institution. The acquirer's report can be accompanied by a presentation using multimedia technology for persuasiveness and confirmation of conclusions and proposals. A copy of the qualification work is placed in the university repository. Attestation is carried out openly and publicly.

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

Program learning outcomes		**Mandatory components of the educational program**									
	OK01	**OK02**	**OK03**	**OK04**	**OK05**	**OK06**	**OK07**	**OK08**	**OK09**	**OK10**	**OK11**
IC01	+	+	+	+	+	+	+	+	+	+	+
GC01		+	+	+	+	+	+				
GC02						+				+	+
GC03	+	+	+	+	+	+	+	+	+	+	+
GC04								+	+	+	+
GC05	+	+	+	+	+	+	+				
GC06	+							+	+	+	+
GC07								+		+	
GC08								+	+	+	+
GC09	+							+	+	+	+
PC01		+			+						
PC02		+	+	+	+	+	+				
PC03			+		+		+				
PC04	+			+		+					
PC05	+							+	+	+	+
PC06	+							+	+	+	+
PC07	+							+	+	+	+
PC08	+	+	+	+	+	+	+	+	+	+	+
PC09	+							+	+	+	+
PC10	+			+				+	+	+	+

1. **Matrix of provision of program learning outcomes (LP) with relevant components of the educational program**

Program learning outcomes		Mandatory components of the educational program									
	OK01	OK02	OK03	OK04	OK05	OK06	OK07	OK08	OK09	OK10	OK11
PO01	+									+	
PO02			+	+							
PO03		+			+						
PO04		+		+	+		+				
PO05			+			+	+				
PO06			+			+					
PO07	+							+	+	+	+
PO08	+							+		+	+
PO09	+							+	+	+	+
PO10	+							+	+	+	+
PO11	+							+	+	+	+
PO12	+							+	+	+	+

Guarantor of the program

Tamara FASTOVSCA