Mining and Metallurgical Institute named after O.A. Baikonurov
«Mine Surveying and Geodesy» department

EDUCATIONAL PROGRAM
8D07309 - «Geomatics, Geodesy and Geospatial Sciences»

Code and classification of the field of education: **8D07 Engineering, Manufacturing and Civil engineering**
Code and classification of training areas: **8D073 Architecture and Civil engineering**
Group of educational programs: **D123 Geodesy**
Level based on NQF: 8
Level based on IQF: 8
Study period: 3 years
Amount of credits: 180

Алматы 2025

Educational program 8D07309 – «Geomatics, Geodesy and Geospatial Sciences» was approved at a meeting of the Academic Council of KazNRTU named after K.I.Satbayev.
Protocol №6 of 6.03.2025
Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after K.I.Satbayev.
Protocol №2 of 20.12.2024

Educational program 8D07309 – «Geomatics, Geodesy and Geospatial Sciences» developed by the academic committee in the direction of «Architecture and Civil engineering»

Full name	Academic degree/ academic title	Position	Place of work	Signature
Academic staff:				
Meirambek Guldana	PhD in Technical Sciences, Associate Professor	Head of Department of Surveying and geodesy	NPJSC «K.I. Satbayev Kazakh National Research Technical University»	
Zhakypbek Yryszhan	PhD, Associate Professor	Professor	NPJSC «K.I. Satbayev Kazakh National Research Technical University»	
Aitkazinova Shynar Kasymkanovna	PhD	Associate Professor	NPJSC «K.I. Satbayev Kazakh National Research Technical University»	
Employer:				
Mukhametov Yesen Serikovich	-	Acting Director	Almaty Regional Branch of RSE «GOSGRADCADASTR»	
Student:				
Iskakov Bolatbek Meirambekuly	-	1st year Doctoral Student	NPJSC «K.I. Satbayev Kazakh National Research Technical University»	

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List of abbreviations and designations

Reduction	Full name
SU	Satbayev University
MSHE RK	Ministry of Science and Higher Education of the Republic of Kazakhstan
AS	Academic staff
EP	Educational program
WC	Working curriculum
GIS	Geographic information system
LOED	Learning outcomes of the educational program
BD	Basic discipline
PD	Profile discipline
TUC	The university component
CC	Component of choice
SDG	Sustainable Development Goals
TUN	The United Nations

The educational program of the doctoral program "Geomatics, Geospatial Sciences" is aimed at training a new generation of scientific, technical and engineering personnel with world-class competencies in the field of digital technologies. The program is based on the integration of fundamental physics and mechanics education with practice-oriented engineering training and active research activities. The main focus is on the development and implementation of innovative methods in the fields of geodesy, cartography, geoinformatics, land management and surveying, including the use of artificial intelligence and geoinformation systems.

The aim of the program is to train specialists capable of conducting scientific research and solving applied problems using advanced geospatial technologies, critically comprehend and develop existing methods, develop and implement new approaches for sustainable management of territories and spatial data. The educational program "Geomatics, Geospatial Sciences" contributes to the implementation of the UN Sustainable Development Goals (SDGs):

SDG 4. Quality education is the development of an academic training system that ensures a high level of research competence, critical thinking and scientific independence, as well as the formation of a culture of continuous learning and professional development.

SDG 9. Industrialization, innovation and infrastructure — support for scientific and technological progress through the training of specialists capable of developing and implementing digital solutions in infrastructure projects, using geoinformation technologies for spatial planning and territorial development.

SDG 12. Responsible consumption and production is the creation and implementation of spatial monitoring technologies aimed at effective and environmentally sound management of natural resources, land management and production activities.

SDG 13. Combating climate change — the use of geospatial data and modeling methods to study and predict climate processes, develop evidence-based

measures to adapt and reduce the negative effects of climate change.

SDG 15. Conservation of terrestrial ecosystems is the use of digital methods of geomatics and remote sensing to assess the state of lands, protect ecosystems, restore natural territories and rational land use.

1. Description of the educational program

Training of scientific, technical and engineering personnel with world-class competencies in the field of digital technologies based on the integration of fundamental physical-mechanical and practice-oriented engineering education with research and development for geodesy, cartography, geoinformatics, land management and surveying.

2. The purpose and objectives of the educational program

Goal EP: creation, based on the integration of education and science, of an effective system for training scientific, scientific and pedagogical personnel of a new formation capable of solving issues of improving society, economy, production, science and the development of new technologies in the field of geodesy, geospatial digital engineering.

Tasks EP:

Task 1: The readiness of specialists for research and project work in the field of geodesy, cartography, geoinformatics, including in related fields related to the selection of necessary research methods, modification of existing and development of new methods based on the objectives of a specific study.

Task 2: The readiness of specialists to develop and implement methods of technologies at the local level to solve problems in the field of geospatial technologies.

Task 3: The readiness of specialists to search for and obtain new information necessary to solve professional tasks in the field of knowledge integration in relation to their field of activity, to actively participate in the activities of an enterprise or organization.

Task 4: The readiness of specialists for scientific, informational, ideological and problematic communications in the professional environment and in the audience of non-specialists with a clear and deep justification of their position, to engage in organizational, managerial and service activities, to be aware of the responsibility for making their professional decisions.

Task 5: The readiness of specialists for self-study and continuous professional development.

Task 6: Willingness to analyze scientific publications and to present in writing the results of their own research in accordance with accepted norms in a foreign language.

Task 7: Willingness to navigate in modern approaches, methods and means of study, as well as trends and ways of developing methods for solving the problem.

3. Requirements for the evaluation of learning outcomes of the educational

program

Learning outcomes include knowledge, skills and competencies and are defined both for the general education program and for its individual modules, disciplines or tasks.

The main task at this stage is to choose methods and means of evaluation for all types of control, with the help of which it is possible to effectively assess the achievement of the planned learning outcomes at the subject level.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	8D07 Engineering, Manufacturing and Civil engineering
2	Code and classification of training directions	8D073 Architecture and Civil engineering
3	Educational program group	D123 Geodesy
4	Educational program name	8D07309 Geomatics, Geodesy and Geospatial Sciences
5	Short description of educational program	Training of scientific, technical and engineering personnel with world-class competencies in the field of digital technologies based on the integration of fundamental physical-mechanical and practice-oriented engineering education with research and development for geodesy, cartography, geoinformatics, land management and surveying.
6	Purpose of EP	Creation, based on the integration of education and science, of an effective system for training scientific, scientific and pedagogical personnel of a new formation capable of solving issues of improving society, economy, production, science and the development of new technologies in the field of geodesy, geospatial digital engineering.
7	Type of EP	New EP
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	No
11	List of competencies of educational program	**General cultural competencies (GCC)** **GCC-1.** Proficiency in oral and written professional communication in Russian, Kazakh and a foreign language, including scientific and business communication in the field of geomatics, geodesy and geospatial sciences. **GCC-2.** Ability to work in a team, participate in interdisciplinary projects, and effectively interact with representatives of the scientific, engineering, and manufacturing communities. **GCC-3.** The ability to make informed decisions in non-standard situations, developed critical thinking and the

		ability to assess the consequences of their actions in a professional environment. **GCC-4.** Skills in planning, self-organization, and time management when performing scientific research and engineering tasks in resource-limited settings. **General Professional Competencies (GPC)** **GPC-1.** Knowledge of the regulatory framework in the field of geodesy, cartography, land management, geoinformatics, including safety standards and environmental regulation. **GPC-2.** Knowledge of modern methods of geodetic and cartographic measurements, including the use of classical and digital technologies for spatial data collection. **GPC-3.** Skills of spatial analysis, visualization and interpretation of data using specialized software (GIS, CAD, photogrammetry, remote sensing, etc.). **GPC-4.** Application of methods for monitoring natural and anthropogenic objects, including using remote sensing, unmanned aerial vehicles, GNSS systems and other digital platforms. **GPC-5.** Understanding the principles of sustainable territorial development, geospatial planning and rational use of natural resources. **Professional Competencies (PC)** **PC-1.** Conducting scientific research in the field of geomatics and geospatial sciences, including the development, adaptation and validation of new data analysis methods. **PC-2.** Creation and maintenance of digital maps, geoportals, spatial models and thematic layers for scientific, design and management tasks. **PC-3.** The use of intelligent and analytical technologies (including artificial intelligence, machine learning) for processing and interpreting large amounts of spatial data. **PC-4.** Participation in the development of project and scientific documentation, writing scientific articles, presenting research results in a professional environment and in front of a wide audience. **PC-5.** Participation in interdisciplinary and international projects aimed at developing and implementing geospatial solutions for sustainable development. **PC-6.** Analysis of foreign scientific publications and preparation of own research materials in a foreign language in accordance with academic standards. **Digital Competencies (DC)** **DC-1.** Knowledge of modern software products for geo-data processing: ArcGIS, QGIS, AutoCAD Civil 3D, Global Mapper, ERDAS Imagine, ENVI, Pix4D, Micromine, Surfer, etc **DC-2.** The ability to create, analyze, and use digital terrain models, 3D models, maps, and visualizations of spatial

		processes. **DC-3.** Knowledge of the principles of working with spatial databases, geoinformation platforms, and geodata storage/exchange systems. **DC-4.** The use of cloud services, Web-GIS and online cartographic solutions for joint scientific and project activities in a digital environment.
12	Learning outcomes of educational program	1.Analyze contemporary scientific trends and promising research directions in geomatics, geodesy, and geospatial sciences. Apply geographic information systems and machine learning methods to tackle scientific and practical challenges within these disciplines. 2.Utilize mathematical, numerical, and computer models to analyze and solve applied problems in geodesy and geospatial sciences. Demonstrate proficiency in using modern information and educational technologies for planning and managing engineering-geodetic work throughout all stages of construction and in the operation of precision and engineering structures. 3.Integrate artificial intelligence methods into geospatial modeling to enhance accuracy and efficiency in applied research and project tasks aimed at addressing specific scientific and practical problems. 4.Develop a comprehensive worldview as a scholar focused on spatial aspects of the surrounding environment. Enhance skills in applying geoinformatic analysis and modern analytical tools within the context of professional and managerial decision-making. 5.Apply knowledge of intellectual property and the commercialization of scientific research results to effectively protect and leverage personal innovations in geomatics on the global market. 6.Cultivate the ability to analyze and interpret data in geomatic research, with an emphasis on applying this data to address industrial issues and implement results across various applied sectors. 7.Critically analyze scientific publications and present research findings in a foreign language, adhering to international standards of academic writing.
13	Education form	Full-time
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Russian, Kazakh
17	Academic degree awarded	Doctor by profile
18	Developers and authors	Department of MSaG

4.2. The relationship between the achievability of the formed learning outcomes according to the educational program and academic disciplines

№	Name of the discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)							
				LR1	LR2	LR3	LR4	LR5	LR6	LR7	LR8
Cycle of basic disciplines University component											
1.	Academic writing	Content: fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, and references; in-text citation; preventing plagiarism; and preparing a conference presentation.	5				v			v	
2.	Methods of scientific research	Purpose: It consists in mastering knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry. Contents: structure of technical sciences, application of general scientific, philosophical and special methods of scientific research, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice.	5				v			v	
Cycle of basic disciplines Elective component											
1.	Mathematical	Objective: Develop a profound	5		v				v		

	methods in geodesy	understanding and skills in applying mathematical methods to solve problems in geodesy and geospatial sciences. Doctoral students will study essential mathematical techniques, including numerical methods, error theory, and linear and nonlinear optimization, used in geodetic calculations and spatial data analysis. The focus will be on applying these methods to solve scientific and applied challenges, such as precise coordinate determination, earth surface modeling, deformation analysis, and other engineering tasks, including geodetic work in construction. Students will also explore the software and computational technologies necessary for effective problem-solving.									
2.	Geographic Information Systems and Machine Learning	Objective: Master the methods and tools of geographic information systems (GIS) and machine learning for spatial data analysis and the resolution of applied problems in geodesy and geospatial sciences. Doctoral students will learn both basic and advanced GIS techniques, including data collection, processing, and visualization. They will also master machine learning algorithms applied to spatial data to automate and enhance analysis accuracy. The course emphasizes practical applications of GIS and machine learning for scientific and practical issues in geodesy and geomatics, including terrain modeling, land use analysis, natural phenomenon forecasting, and infrastructure project optimization.	5	**v**			**v**				
3.	Intellectual property	The goal is to train specialists in the field of	5					**v**	**v**		

	and the global market	intellectual property law who can analyze and predict trends in its development in the global market, develop strategies for the protection and commercialization of intellectual property. Contents: global aspects of intellectual property and its role in international trade and economics, analysis of international agreements and conventions, IP management strategies, cases of protection and violation of intellectual property rights in various jurisdictions.									
Cycle of profile disciplines Elective component											
1.	Integration of Artificial Intelligence into Geospatial Modeling	Equip doctoral students to effectively use artificial intelligence (AI) methods to enhance accuracy and efficiency in geospatial modeling for scientific and applied research. Students will master fundamental and advanced AI techniques, such as neural networks, deep learning, image processing, and big data analytics, applied to geospatial research. The course will focus on the practical use of AI for specific scientific and industrial problems, such as forecasting, automating geodetic surveys, improving spatial model quality, and developing intelligent decision support systems.	5		**v**	**v**					
2.	Geoinformation analysis for scientific research	Develop skills in applying geoinformatic analysis to solve scientific problems related to spatial data research and interpretation. Doctoral students will study methods of spatial analysis, geostatistics, spatial	5	**v**			**v**				

		modeling, and data visualization, as well as their application to scientific and applied tasks. The course includes practical work with advanced GIS and spatial analysis software, aimed at studying earth processes, environmental monitoring, and resource management strategy development. PhD students will also learn methods for integrating spatial data with other information sources to create comprehensive models and maps.									
3.	Geomatics in the research of geospatial data	Develop skills in applying geomatics methods to analyze and interpret geospatial data with a focus on solving industrial problems. Doctoral students will study fundamental and advanced geomatics techniques, including remote sensing, GNSS technology, photogrammetry, and laser scanning, and their application in various fields. The emphasis will be on the scientific and practical use of these methods to address real industrial problems, such as land resource management, infrastructure monitoring, urban planning, and environmental protection. PhD students will also master specialized software for processing and analyzing geospatial data.	5				**v**		**v**		

5. Curriculum of the educational program

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year	2025-2026 (Autumn, Spring)
Group of educational programs	D123 - "Geodesy"
Educational program	8D07309 - "Geomatics, geodesy and geospatial sciences"
The awarded academic degree	Doctor of Engineering (Industry)
Form and duration of study	full time (professional track) - 3 years

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters						Prerequisites
									1 course		2 course		3 course		
									1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
CYCLE OF BASIC DISCIPLINES (BD)															
M-1. Module of basic training (university component)															
MET322	Methods of scientific research		BD, UC	5	150	30/0/15	105	E	5						
LNG305	Academic writing		BD, UC	5	150	0/0/45	105	E	5						
MAP330	Geographic Information Systems and Machine Learning	2	BD, CCH	5	150	15/0/30	105	E	5						
MAP316	Mathematical methods in geodesy	2	BD, CCH	5	150	15/0/30	105	E	5						
MNG349	Intellectual property and the global market	2	BD, CCH	5	150	30/0/15	105	E	5						
CYCLE OF PROFILE DISCIPLINES (PD)															
M-2. Module of professional activity (component of choice)															
MAP331	Integration of Artificial Intelligence into Geospatial Modeling		PD, UC	5	150	15/0/30	105	E	5						
MAP324	Geomatics in the research of geospatial data	1	PD, CCH	5	150	15/0/30	105	E	5						
MAP332	GeoinFormation analysis for scientific research.	1	PD, CCH	5	150	30/0/15	105	E	5						
M-3. Practice-oriented module															
AAP371	Industrial internship	1	PD, UC	20				R		20					
M-4. Experimental research module															
AAP372	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	5				R	5						
AAP376	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	10				R		10					
AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	30				R			30				
AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	30				R				30			
AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	30				R					30		
AAP375	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	18				R						18	
M-5.Module of final attestation															
ECA325	Final examination (writing and defending a doctoral dissertation)		FA	12										12	
Total based on UNIVERSITY:									30	30	30	30	30	30	
									60		60		60		

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	10	5	15
PD	Cycle of profile disciplines	0	25	5	30
Total for theoretical training:		**0**	**35**	**10**	**45**

RWDS	Research Work of Doctoral Student				0
ERWDS	Experimental Research Work of Doctoral Student				123
FA	Final attestation				12
TOTAL:					**180**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 12.12.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs — Uskenbayeva R. K.

Approved:

Vice Provost on academic development — Kalpeyeva Z. S.

Head of Department - Department of Educational Program Management and Academic-Methodological Work — Zhanagaliyeva A. S.

Director - Mining and Metallurgical Institute named after O.A. Baikonurov — Ryabkov K. .

Department Chair - Surveying and geodesy — Maimanbek G. .

Representative of the Academic Committee from Employers ___Acknowledged___ — Mukhametov Y.