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

EDUCATIONAL PROGRAM
8D07306 - «Geospatial digital Engineering»

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 8D07306 – «Geospatial digital Engineering» 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 8D07306 – «Geospatial digital Engineering» 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 "Geospatial Digital Engineering" is aimed at training highly qualified scientific and engineering personnel of a new formation, capable of developing and implementing innovative solutions in the field of geodesy, geoinformatics, cartography, land management and surveying. The program integrates fundamental physics and mathematics education, engineering and technical training and active research activities, forming world-class competencies in the field of digital geospatial technologies for doctoral students. The program makes a significant contribution to the implementation of the Sustainable Development Goals (SDGs) approved by the United Nations through the development of scientific potential, digitalization of the geospatial industry and support for sustainable practices of territorial development.:

SDG 4. Quality education is the provision of a high level of academic training, the development of independent research skills, critical analysis and the generation of new knowledge, as well as the formation of a sustainable trajectory of continuing education and professional development.

SDG 9. Industrialization, innovation, and Infrastructure — support scientific and technological progress through the training of researchers and developers who create and implement digital engineering solutions in geospatial systems and infrastructure projects.

SDG 12. Responsible consumption and production is the development of digital monitoring and environmental management methods, the introduction of solutions to optimize the use of resources and improve the environmental sustainability of territories.

SDG 13. Combating climate change is the application of geoinformation technologies for the analysis, modeling and forecasting of climate processes, as well as for the development of adaptation strategies based on spatial data.

SDG 15. Conservation of terrestrial ecosystems is the support of the protection and restoration of natural ecosystems through scientifically sound land use, environmental impact assessment and spatial planning of natural territories.

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	8D07306 Geospatial Digital Engineering
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 effective oral and written communication in Russian, Kazakh and a foreign language in an academic and professional environment in the field of geodesy, cartography, geoinformatics and related fields. **GCC-2.** The ability to work in a team, to organize joint scientific and project activities with representatives of the engineering, scientific and industrial sectors. **GCC-3.** The ability to make informed and responsible professional decisions in non-standard situations, demonstrating critical and engineering thinking. **GCC-4.** Self-organization and time management skills; the ability to set goals and achieve results in conditions of limited resources. **General Professional Competencies (GPC)** **GPC-1.** Knowledge of the regulatory framework governing activities in the field of geodesy, land management, surveying and environmental management,

		including aspects of environmental and industrial safety. **GPC-2.** Knowledge of modern methods and technologies of geodetic, surveying and cartographic measurements at various stages of design and operation. **GPC-3.** Skills in collecting, processing, analyzing, and visualizing spatial information in order to build digital and analog terrain models. **GPC-4.** The use of spatial monitoring technologies (including remote methods and GNSS systems) to assess the condition of objects and territories. **GPC-5.** Understanding the engineering, legal, environmental, and digital aspects of conducting and supporting geospatial science projects. **Professional Competencies (PC)** **PC-1.** Performing scientific and applied research in the field of geomatics and digital engineering, including the development and adaptation of new spatial analysis methods. **PC-2.** Application of geographic information systems (GIS), photogrammetry, laser scanning and remote sensing methods for the study and management of the territory. **PC-3.** Creation and updating of digital maps, plans, models and thematic layers of spatial information for scientific, engineering and management tasks. **PC-4.** Integration of spatial data and their interpretation using specialized software in scientific research. **PC-5.** Participation in the development of territorial and sectoral projects, including environmental impact assessment and sustainable management of natural resources. **PC-6.** Preparation of scientific publications, accounting and project documentation, participation in scientific conferences and professional communications. **Digital Competencies (DC)** **DC-1.** Knowledge of modern spatial data processing software, including AutoCAD Civil 3D, ArcGIS, QGIS, ERDAS Imagine, ENVI, MapInfo, Micromine, Surpac, etc **DC-2.** The ability to work with digital terrain models, geographic information databases, 3D models and satellite images. **DC-3.** Knowledge of the principles of building, managing, and analyzing spatial databases and geoportals. **DC-4.** The use of web cartography, cloud platforms, and Web-GIS for visualization, publication, and collaboration on spatial data in scientific and industrial environments.
12	Learning outcomes of educational program	1.Analyze the trends of modern science, identify promising areas of scientific research in the subject area of professional activity, the composition of research papers, their determining factors.

		2.To use methods of mathematical, numerical and computer modeling in the analysis and solution of applied and engineering problems, exhibiting the skills of expanding their knowledge based on information and educational technologies. 3.Gain in-depth knowledge in the subject area of professional activity, reflecting the current level of development. 4.To form a conceptual worldview of a future scientist in terms of studying the spatial aspects of the surrounding world when making professional and/or managerial decisions. 5.Use a mathematical-statistical approach to spatial problems, including methods from geoinformation systems and packages for statistical data processing. 6.To be guided by modern approaches, methods and means of studying the shape and external gravitational field of the Earth and other planets, as well as trends and ways of developing methods for solving this problem. 7.Analyze scientific publications and present in writing the results of their own research in accordance with accepted norms in a foreign language.
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 of Philosophy PhD
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	
2.	Methods of scientific research	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							
Cycle of basic disciplines Elective component											
1.	Mathematical methods in geodesy	Doctoral students will study essential mathematical techniques, including numerical methods, error theory, and linear and nonlinear optimization, used in geodetic calculations and spatial data	5		v			v			

		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.	Mathematical modeling of deformation processes	Contents: Study of methods of correlation and regression analysis to establish trends in the dynamics of deformation processes; cellular automata to create predictive models of subsidence; forecasting of deformations of the Earth's surface, buildings and structures based on the results of geodetic observations using available quantitative and qualitative data of other types of field observations in Matlab software during research.	5		v			v			
3.	Intellectual property and the global market	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.	5	v						v	
Cycle of profile disciplines Elective component											
1.	Geoinformation analysis for scientific research	Doctoral students will study methods of spatial analysis, geostatistics, spatial modeling, and data visualization, as well as their application to scientific and	5			v	v	v			

		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.									
2.	Theory of the figure of the Earth	Contents: As part of the course, the doctoral student will master the possibilities of determining the figure of the Earth by successive approximations using heterogeneous geodetic, gravimetric, astronomical and satellite measurements: the concept of determining the figure of the Earth by its sequential refinement, as well as the relationship of parameters describing the figure and the external gravitational field of the Earth.	5								
3.	Fundamental and applied coordinate-time support of geodesy tasks	The discipline is focused on the formation of ideas and understandings about the main tasks and structure of the fundamental segment, the definition of the celestial and terrestrial reference coordinate systems, simplified models of the celestial and terrestrial systems, the modern level of solving the fundamental coordinate-time support, the parameters of the datum, the requirements for a set of tools, the use of GNSS in coordinate-time support.	5								

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: 8D07306 - "Geospatial Digital Engineering"
The awarded academic degree: Doctor of Philosophy PhD
Form and duration of study: full time (scientific and pedagogical 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						
MAP326	Mathematical modeling of deformation processes	1	BD, CCH	5	150	15/0/30	105	E	5						
MAP316	Mathematical methods in geodesy	1	BD, CCH	5	150	15/0/30	105	E	5						
MNG349	Intellectual property and the global market	1	BD, CCH	5	150	30/0/15	105	E	5						
M-3.Practice-oriented module															
AAP350	Pedagogical practice		BD, UC	10				R		10					
CYCLE OF PROFILE DISCIPLINES (PD)															
M-2.Module of professional activity (component of choice)															
MAP332	Geoinformation analysis for scientific research.		PD, UC	5	150	30/0/15	105	E	5						
MAP328	Theory of the figure of the Earth	1	PD, CCH	5	150	15/0/30	105	E	5						
MAP329	Fundamental and applied coordinate-time support of geodesy tasks	1	PD, CCH	5	150	15/0/30	105	E	5						
M-3.Practice-oriented module															
AAP355	Research practice	1	PD, UC	10				R			10				
M-4.Experimental research module															
AAP336	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	5				R	5						
AAP347	Research work of the doctoral student, including internships and doctoral dissertation	1	RWDS	20				R		20					
AAP347	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	20				R			20				
AAP356	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	30				R				30			
AAP356	Research work of the doctoral student, including internships and doctoral dissertation	1	RWDS	30				R					30		
AAP348	Research work of the doctoral student, including internships and doctoral dissertation	1	RWDS	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	20	5	25
PD	Cycle of profile disciplines	0	15	5	20
Total for theoretical training:		**0**	**35**	**10**	**45**
RWDS	Research Work of Doctoral Student				123
ERWDS	Experimental Research Work of Doctoral Student				0
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 — Zhumagaliyeva A. S.

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

Department Chair - Surveying and geodesy — Meirambek G. .

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