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

EDUCATIONAL PROGRAM
7M07329 - «Geospatial Digital Engineering»

Code and classification of the field of education: **7M07 Engineering Manufacturing and Civil engineering**
Code and classification of training directions: **7M073 Architecture and Civil engineering**
Group of educational programs: **M123 Geodesy**
Level based on NQF: 7
Level based on IQF: 7
Study period: 1,5 years
Amount of credits: 90

Almaty 2025

Educational program 7M07329 – «Geospatial digital Engineering» was approved at a meeting of the Academic Council of KazNRTU named after K.I.Satbayev.
Protocol №6 of 31.03.2025
Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after K.I.Satbayev.
Protocol №2 of 12.03.2025

Educational program 7M07329 – «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»	

Table of contents

List of abbreviations and symbols

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 Geospatial Digital Engineering educational program contributes to the achievement of the priority Sustainable Development Goals (SDGs) approved by the United Nations through the training of highly qualified specialists with expertise in geodesy, geoinformatics, digital modeling and spatial analysis. The program focuses on the formation of professional and research skills necessary to solve problems in the field of sustainable spatial planning, environmental safety, digitalization of the urban environment and modernization of infrastructure. Graduates of the program play a key role in the digital transformation of the geodetic industry, the development and application of sustainable technologies, spatial data management and visualization of territories using advanced methods of aerospace surveying, 3D modeling, GNSS and Web-GIS. Their activities are aimed at implementing national and international goals in the field of sustainable development of territories, reducing the risks of natural and man-made disasters, increasing technological efficiency and environmental resilience of infrastructure projects. The OP contributes to the achievement of the following SDGs:

SDG 4. Quality education is the formation of a sustainable system of high-quality, inclusive and affordable education that provides lifelong learning opportunities

SDG 9. Industrialization, innovation and infrastructure - the development of sustainable infrastructure and the introduction of scientific and technological innovations into the economy of the region and the country.

SDG 12. Responsible consumption and production is the development of a system of environmentally responsible consumption and production based on the principles of reduction, reuse and recycling.

SDG 13. Combating climate change – using geospatial technologies to monitor changes in the environment;

SDG 15. Conservation of terrestrial ecosystems is the monitoring and assessment of land use aimed at protecting and restoring natural ecosystems.

1. Description of the educational program

Designed for the implementation of scientific and pedagogical training of masters in the educational program "Geospatial Digital Engineering" at Satbayev University and developed within the framework of the direction "Geospatial Digital Engineering"

The purpose and objectives of the educational program

Goal EP: the purpose of the program is to train highly qualified scientific, technical and engineering personnel in the field of geodesy, geo informatics, geospatial digital technologies.

Tasks EP:

Task 1: The readiness of specialists for research and design work in the field of geodesy, cartography, geo informatics, mine surveying and land management, including in related areas related to the choice of the necessary research methods, modification of existing and development of new methods based on the objectives of a particular study.

Task 2: Readiness of specialists for production and technological activities that ensure the introduction of new digital developments at the local level

Task 3: The readiness of specialists to search and receive new information necessary to solve professional problems 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 a professional environment and in an 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-learning and continuous professional development during the entire period of scientific or advanced training during the entire period of scientific or professional activity.

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 educational program as a whole and for its individual modules, disciplines or tasks.

The main task at this stage is to select assessment methods and tools for all types of control, with the help of which it is possible to most effectively assess the achievement of planned learning outcomes at the discipline level.

4. Passport of the educational program

4.1 General information

№	Field name	Note
1	Code and classification of the field of education	7M07 Engineering, manufacturing and Civil engineering
2	Code and classification of	7M073 Architecture and civil engineering

	training directions	
3	Educational program group	M123 Geodesy
4	Educational program name	7M07329 Geospatial Digital Engineering
5	Short description of educational program	It is intended for the implementation of scientific and pedagogical training of masters in the educational program "Geospatial Digital Engineering" at Satbayev University and was developed as part of the direction "Geospatial Digital Engineering"
6	Purpose of EP	The purpose of the program is to train highly qualified scientific, technical and engineering personnel in the field of geodesy, geo informatics, geo spatial digital technologies.
7	Type of EP	New EP
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	No
11	List of competencies of educational program	**General cultural competencies (GCC)** **GCC-1**. Ability to communicate effectively in Russian, Kazakh and a foreign language in a professional environment in the field of surveying and mining. **GCC-2**. Teamwork skills, effective interaction with engineers, designers, production staff and government agencies. **GCC-3**. The ability to make informed decisions in non-standard and emergency situations, developed critical and engineering thinking. **GCC-4.** Self-organization skills, the ability to plan professional activities, set goals and achieve them in conditions of limited time and resources. **General Professional Competencies (GPC)** **GPC-1.** Knowledge of the regulatory framework governing surveying, mining and geodetic work, as well as requirements in the field of industrial and environmental safety. **GPC-2.** Knowledge of methods for performing surveying and geodetic measurements in underground and open-pit mines. **GPC-3.** Skills in collecting, analyzing and visualizing spatial information, creating cartographic and graphic materials. **GPC-4.** Application of methods for monitoring deformations of the Earth's surface and mining facilities using ground-based and remote technologies. **GPC-5.** Understanding the engineering, legal, and environmental aspects of mining design, management, and liquidation. **Professional Competencies (PC)** **PC-1.** Performing high-precision surveying operations at all stages of mining production: design, operation,

		conservation, and liquidation. **PC-2**. Conducting aerospace, photogrammetric and laser surveys to monitor and analyze the spatial and temporal state of the subsurface and objects. **PC-3.** Creation of mining and engineering maps, mining plans, underground structures, situational and thematic schemes. **PC-4.** Processing and interpretation of the results of surveying and geodetic measurements using specialized software. **PC-5**. Participation in the design and construction of underground and aboveground engineering structures with full surveying support. **PC-6.** Development of technical documentation, accounting, drafting and participation in scientific and practical publications in the field of surveying. **Digital Competencies (DC)** **DC-1.** Proficiency in professional software for surveying and geodetic data processing (AutoCAD Civil 3D, Micromine, Surpac, Credo, MapInfo, Leica Geo Office, etc.). **DC-2.** The ability to work with digital terrain models, mining operations, 3D models, GNSS data and satellite images. **DC-3.** Knowledge of the basics of working with spatial information databases, geodata storage and processing systems. **DC-4.** The use of Web cartography, Web-GIS and cloud solutions for visualization and collaboration in the surveying and geoinformation environment.
12	Learning outcomes of educational program	1.Acquisition of theoretical knowledge and practical skills in solving applied and scientific problems through geodetic surveys. 2.Possess the skills of free and understandable presentation of thoughts in English and use them as a means of business communication at a professional level. 3.Knowledge of theoretical and practical skills, performing professional tasks when performing geodetic measurement tasks, including the selection of types of geodetic tools and equipment and monitoring them in accordance with IOS standards. 4.Development of plans and programs for the organization of innovation activities at the enterprise using professional automated systems, as well as assessment of economic efficiency. Developing the ability to make optimal management decisions. 5.Understanding the directions of development of technologies for digitalization of geospatial data, readiness to change processes in the face of dynamic changes in the production market, the use of modern

		technologies for visualization and optimization of production processes, and the acquisition of big data management skills in the field of geodesy and cartography. 6.To carry out research and teaching activities, to develop methods of inclusive education, to raise the intellectual and cultural level, as well as to improve the moral and physical development of the individual in the field of professional activity. 7.The introduction of skills in the effective use of management systems, methods of increasing production efficiency and modern information technologies for process automation. 8.Understand and apply in practice the concepts of geospatial analysis, immersion technologies, as well as 3D visualization of aerospace and ground-based visualization methods. 9.Be able to analyze and effectively apply modern computer technologies, including web-based GIS systems, including the creation of database management systems, analysis of mathematical processing methods, implementation of creative initiatives, preparation of applications for inventions and industrial designs.
13	Education form	Full-time
14	Period of training	1,5 years
15	Amount of credits	90
16	Languages of instruction	Russian, Kazakh
17	Academic degree awarded	Master of engineering and technology
18	Developer and authors	Department «Mine Surveying and Geodesy»

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

№	Name of the discipline	Brief description of the discipline	Number of credits	Formed learning outcomes (codes)								
				LR1	LR2	LR3	LR4	LR5	LR6	LR7	LR8	LR9
Cycle of basic disciplines University component												
1	Foreign language (professional)	The purpose of the discipline is to acquire and improve competencies in accordance with trade standards of foreign education, capable of competing in the labor market, because through a foreign language, the future master gains access to academic knowledge, new technologies and modern information, allowing the use of a foreign language as a means of communication in the intercultural, professional and scientific activities of the future master.	2								V	
2	Management	To form a scientific understanding of management as a type of professional activity. Contents: Mastering the general theoretical principles of managing socio-economic systems; acquiring skills and abilities in practical problem-solving of managerial issues; studying global management practices and the specificities of Kazakhstani management; training in solving practical issues related to managing various aspects of organizational activities.	2					V				
3	Psychology of management	To acquire skills in making strategic and managerial decisions, taking into account	2					V				

		the psychological characteristics of the individual and the team. Content: the modern role and content of psychological aspects in management activities, methods for improving psychological literacy, the composition and structure of management activities, both at the local and foreign levels, the psychological feature of modern managers.										
Cycle of basic disciplines Selectable Component												
4	Methods for creating and developing state geodetic networks	Purpose: studying methods of traditional and satellite geodesy for constructing state geodetic networks (GNS), as well as for harmonizing networks built by these methods. Contents: As part of the course, the master's student will master methodological approaches to the development, creation, modernization and use of the state geodetic network; traditional and satellite methods for constructing a state geodetic network, methods for conducting geodetic measurements at GGS points, adjusting geodetic networks.	5									
5	Aerospace environmental monitoring	Purpose: regular monitoring and gathering of information using aviation and space technology in order to assess and predict the state of any objects, processes, phenomena (environmental conditions, activities of conflicting parties, etc.).	5									

		Contents: The cartographic method is the study of the structure, interrelationships, dynamics and evolution of phenomena in time and space using maps, the forecast of their development, and obtaining all kinds of qualitative and quantitative characteristics.										
6	Spatial data infrastructure	Purpose: the aim is to study the creation and development of a spatial data infrastructure that provides access to spatial data and its effective use. Content: the study of the use of geodetic and cartographic methods in solving problems of creating databases of spatial and temporal data, environmental monitoring. The study of GIS packages, spatial data sources for solving professional tasks.	5									
7	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5									
8	Innovative methods of engineering and geodetic works	Purpose: mastering methods for collecting, processing and analyzing Earth remote sensing data in the study of natural resources. Contents: As part of the course, the undergraduate will master the theoretical	5									

		and practical use of innovative methods and technologies to solve scientific and applied problems. The main content of the course contains the following sections: GNSS, absolute and relative shooting methods (kinematics and statics), post-processing and real-time processing; UAVs and shooting methods; laser scanning and shooting methods (VLF, MLS, NLS) when performing engineering and survey, geodetic works.										
9	Innovative Approaches to Teaching Land Management in an Inclusive Educational Environment	Objective: To develop students' knowledge and skills in land management using innovative teaching methods within an inclusive educational environment, ensuring equal access to spatial thinking and professional training. Principles of inclusive education. Digital tools in land management training. Adaptation of educational materials. Working with GIS and remote sensing. Personalized learning approaches. Project tasks designed for students with special educational needs.	5									
10	Sustainable Business Project Management	Objective: To ensure financial stability and long-term profitability of a project, enabling the achievement of business goals while delivering value to investors, employees, and other stakeholders. Emphasis is placed on long-term economic efficiency and minimizing environmental impact. Key activities include the development of sustainable development strategies,	5									

		resource management, integration of sustainable practices into project management, risk assessment and mitigation, staff training and development, and the adoption of innovative approaches and technologies.										
11	Geological-Mathematical Modeling	Objective: To develop and apply mathematical models for the description, analysis, and prediction of geological processes and phenomena. Modeling enables efficient exploration of various geological objects and processes, supporting practical tasks in hydrogeology, geophysics, mineral extraction, and environmental studies. Key activities include the development of mathematical models of geological processes, analysis and interpretation of geophysical data, forecasting and assessment of natural hazards, optimization of mineral resource development, and evaluation of environmental impact.	5									
12	Technology for automating the land survey process	Purpose: the discipline is to study modern methods and tools that allow automating the processes of collecting, analyzing and interpreting data on land plots. Contents: The discipline "Technology for Automating the Land Research Process" includes the study of modern methods and tools for collecting, analyzing and interpreting data on land resources, optimizing land management and	5									

		developing innovative approaches to the assessment and use of land plots.										
13	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5									
Cycle of major disciplines University component												
14	Big data in geosciences	Purpose: the discipline is focused on the formation of ideas and understandings about the phenomenon of Big Geospatial Data, models of geospatial data and technologies for searching and analyzing this data. Contents: As a result of studying the subject, the undergraduate must master the concept of using big data in geosciences; use the basic capabilities of the tool to load and visualize big data; apply intelligent big data processing technologies; ensure the security of big data.	5									

15	Organization of topographic and geodetic works	Purpose: The discipline aims to acquire knowledge and skills in the organization of topographic and geodetic works, using modern methods and methods to solve applied problems in production and scientific research. Contents: The main content of the discipline includes the following sections: planning of topographic and geodetic works, budgeting and calculation of costs for the organization and liquidation of works during geodetic surveys, organizational and legal forms of enterprises, fixed assets of the enterprise, labor productivity, the basics of labor rationing.	5									
16	Remote sensing of the Earth and natural resources	Purpose: the study of the theoretical foundations and practical skills of observing the Earth's surface by ground and remote methods. Contents: formation of remote sensing data processing skills using modern software, classification and interpretation of the results obtained, correct design of the results and preparation of accounting documentation.	4									
17	Spatial analysis	Purpose: is to train undergraduates in methods of analysis and interpretation of spatial data using modern tools of geoinformatics and statistics. Contents: The discipline "Spatial Analysis" includes the study of methods for analyzing geographic data, visualization, statistics of spatial data,	5									

		spatial modeling, the application of GIS in various fields and the acquisition of practical skills in working with software tools for analyzing spatial data.										
18	Monitoring the deformation processes of buildings and structures	Purpose: Formation of knowledge and practical skills in the field of monitoring deformation processes of buildings and structures to solve scientific and technical problems for their safe operation. Contents: As a result of studying the subject, the undergraduate must master theoretical practical skills in measuring elevations of parts of buildings and structures; stress state in soil masses and structures of buildings and structures; horizontal movements of soil masses limited by slopes or slopes.	5									
19	Fundamentals of Scientific Research	Objective: To develop students' foundational knowledge and skills in scientific thinking, research planning and execution, and academic writing. Concept of science and scientific method. Stages of research. Setting goals and objectives. Literature review. Data collection and analysis methods. Structure of a research paper. Basics of academic ethics and citation.	5									
20	Geospatial data visualization	The purpose of studying the discipline is to master the methods and concept of visual representation of spatial data of mountain objects obtained as a result of surveying, geodetic measurements for making managerial decisions. Content: visualization and representation methods	4									

		for mountain objects; interactive approaches to isosurface contouring for geovisualization; interpretation of spatial analysis results; modeling of virtual environments for solving professional tasks.										
Cycle of major disciplines Selectable Component												
21	WEB-GIS	Purpose: the study of theoretical and practical aspects of web GIS. Contents: formation of ideas and understandings about the concepts and technical foundations of web GIS; exploring the possibilities of web GIS technologies using ESRI products (ArcGIS online, server) and open resources (QGIS, Mapserver, Geoserver); geospatial web services, geoportals, meshes, mobile GIS, creating interactive online maps for solving problems in the field of geodesy, cartography, surveying.	5									
22	Land management using WEB-GIS	The purpose of mastering the discipline "Land management with the use of WEB-GIS" with the use of WEB-GIS is to form a holistic view of land use management in modern conditions, knowledge of the scientific and theoretical foundations of land use management.	5									

5. Curriculum of the educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 31.03.2025 Minutes № 12

WORKING CURRICULUM

Academic year	2025-2026 (Autumn, Spring)
Group of educational programs	M123 - "Geodesy"
Educational program	7M07329 - "Geospatial Digital Engineering"
The awarded academic degree	Master of engineering and technology
Form and duration of study	full time (professional track) - 1,5 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	
									1 sem	2 sem	3 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)												
CYCLE OF BASIC DISCIPLINES (BD)												
M-1. Module of basic training (university component)												
LNG212	Foreign language (professional)		BD, UC	2	60	0/0/30	30	E	2			
MNG726	Management		BD, UC	2	60	15/0/15	30	E	2			
HUM211	Psychology of management		BD, UC	2	60	15/0/15	30	E	2			
MAP709	Methods for creating and developing state geodetic networks	1	BD, CCH	5	150	15/0/30	105	E	5			
MAP201	Aerospace environmental monitoring	1	BD, CCH	5	150	30/0/15	105	E	5			MAP112
MAP713	Spatial data infrastructure	2	BD, CCH	5	150	15/0/30	105	E	5			
MNG781	Intellectual property and research	2	BD, CCH	5	150	30/0/15	105	E	5			
MAP701	Innovative methods of engineering and geodetic works	2	BD, CCH	5	150	15/0/30	105	E	5			
MAP748	Innovative Approaches to Teaching Land Management in an Inclusive Educational Environment	2	BD, CCH	5	150	15/0/30	105	E	5			
MAP751	Sustainable Business Project Management	1	BD, CCH	5	150	15/0/30	105	E		5		
MAP752	Geological-Mathematical Modeling	1	BD, CCH	5	150	15/0/30	105	E		5		
MAP708	Technology for automating the land survey process	1	BD, CCH	5	150	15/0/30	105	E		5		
MNG782	Sustainable development strategies	1	BD, CCH	5	150	30/0/15	105	E		5		
CYCLE OF PROFILE DISCIPLINES (PD)												
M-2. Module of professional activity (university component, component of choice)												
MAP717	Big data in geosciences		PD, UC	5	150	15/0/30	105	E	5			
MAP258	Organization of topographic and geodetic works		PD, UC	5	150	15/0/30	105	E	5			
MAP265	Remote sensing of the Earth and natural resources		PD, UC	4	120	15/0/30	75	E	4			
MAP716	Spatial analysis		PD, UC	5	150	15/0/30	105	E		5		
MAP271	Monitoring the deformation processes of buildings and structures		PD, UC	5	150	15/0/30	105	E		5		
MAP746	Fundamentals of Scientific Research		PD, UC	5	150	0/0/45	105	E		5		
MAP710	WEB-GIS	1	PD, CCH	5	150	15/0/30	105	E		5		
MAP712	Land management using WEB-GIS	1	PD, UC	5	150	15/0/30	105	E		5		
MAP272	Geospatial data visualization		PD, UC	4	120	15/0/15	90	E			4	
M-3. Practice-oriented module												
AAP248	Internship		PD, UC	5				R		5		
M-4. Experimental research module												
AAP249	Experimental research work of a master student, including an internship and the implementation of a master's project		ERWMS	18				R			18	
M-5. Module of final attestation												
ECA213	Design and defense of the master's project		FA	8							8	

Total based on UNIVERSITY:	30	30	30	
	60		**30**	

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	6	15	21
PD	Cycle of profile disciplines	0	38	5	43
Total for theoretical training:		**0**	**44**	**20**	**64**
RWMS	Research Work of Master's Student				0
ERWMS	Experimental Research Work of Master's Student				18
FA	Final attestation				8
TOTAL:					**90**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes №5 dated 12.03.2025

Decision of the Academic Council of the Institute. Minutes №5 dated 23.01.2025

Signed:

Governing Board member - Vice-Rector for Academic Affairs	Uskenbayeva R. K.
Approved:	
Vice Provost on academic development	Kalpayeva Z. B.
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	Ryzhakov K. .
Department Chair - Surveying and geodesy	Maimanbek G. .
Representative of the Academic Committee from Employers ___Acknowledged___	Mukhametov Y.