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

EDUCATIONAL PROGRAM
7M07306 - «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: 2 years
Amount of credits: 120

Almaty 2025

Educational program 7M07306 – «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 7M07306 – «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:				
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Employer:				
Mukhametov Yesen Serikovich	-	Acting Director	Almaty Regional Branch of RSE «GOSGRADCADASTR»	
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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"

2. 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	7M07 Engineering, manufacturing and Civil

	field of education	engineering
2	Code and classification of training directions	7M073 Architecture and civil engineering
3	Educational program group	M123 Geodesy
4	Educational program name	7M07306 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.Master theoretical and practical skills in conducting geodetic surveys to solve applied and scientific problems. 2.Apply the skills to express your thoughts fluently and clearly in English and use them as a means of business communication at a professional level. 3.To gain theoretical and practical skills, to carry out professional functions in the tasks of rational production of geodetic measurements, including substantiation of the type and type of geodetic instruments and equipment, their control in accordance with IOS standards. 4.Be able to develop plans and programs for the organization of innovative activities at the enterprise and understand the economic efficiency using professional automated systems. Make optimal management decisions 5.Understand the trends in the development of digitalization technologies for geospatial data, to be ready to transform processes in the context of dynamic changes

		in processes in the production market, apply modern technologies to visualize and optimize production processes, manage big data in the field of geodesy and cartography. 6.Conduct research and pedagogical work, improve the intellectual and general cultural level, improve the moral and physical development of one's personality in the competence of professional activity. 7.Apply the skills of control systems, means of improving production efficiency and adapting modern information technologies to automate processes. 8.Understand and apply the concepts of geospatial analysis, immersive technologies, and 3D visualization of aerospace and ground imaging techniques. 9.Be able to analyze and apply modern computer technologies, including Web-based GIS for creating database management systems, analyzing mathematical processing methods, the ability to take creative initiative, prepare applications for inventions and industrial designs.
13	Education form	Full-time
14	Period of training	2 years
15	Amount of credits	120
16	Languages of instruction	Russian, Kazakh
17	Academic degree awarded	Master of Technical Sciences
18	Developers and authors	Department MSaG

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 course is aimed at studying the main problems of scientific knowledge in the context of its historical development and philosophical understanding, the evolution of scientific theories, principles and methods of scientific research in the historical construction of scientific paintings of the world. The discipline will help to master the skills of developing critical and constructive scientific thinking based on research on the history and philosophy of science. At the end of the course, undergraduates will learn to analyze the ideological and methodological problems of science and engineering and technical activities in building Kazakhstan's science and the prospects for its development.	3								v	
2	History and philosophy of science	The subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3					v				

3	Higher school pedagogy	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select the content of training sessions. Organize the educational process on the basis of credit technology of education.	3					v				
4	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image, analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.	3					v				
Cycle of basic disciplines Selectable Component												
5	Innovative methods of engineering and geodetic works	As part of the course, the undergraduate will master the theoretical 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	5									v

		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.										
6	Spatial Data Infrastructure	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							v		
7	Mathematical modeling of field indicators	The discipline studies the basic methods of mathematical modeling and their application in applied mining and geological sciences, the theory of mathematical modeling, which allows you to build models of field indicators and judge their adequacy; scientific approaches to modeling field indicators; the basics of mathematical thinking, the use of mathematical language.	5						**v**	**v**		
8	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.										
9	Sustainable development strategies	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.										
10	Methods for the creation and development of state geodetic networks	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				v					v
11	Technology for automating the land survey process	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 developing innovative approaches to the assessment and use of land plots.	5	v	v							
12	Aerospace environmental monitoring	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.	5			v				v		
13	Sustainable business and project management	Discipline ""Sustainable Business and Project Management"" for undergraduates is aimed at teaching the principles and methods of creating and managing sustainable business projects, including the development of sustainable development strategies and the use of project management tools in conditions of variability and uncertainty. Undergraduates master project management methodologies, develop risk analysis and assessment skills, and prepare to solve case	5									

		studies and participate in practical projects related to sustainable business. As a result of the training, they acquire the ability to develop strategies for sustainable business development, plan, monitor and complete projects, as well as analytical and practical skills for effective management of sustainable business projects."										
14	Methodology of continuous career design in inclusive education	Objective: it is aimed at mastering the methodology of continuous quarry design in market conditions, taking into account existing and new methods of intensive construction, technical re-equipment, phased development of deposits, adjustments to the mining transportation system, reconstruction and operation of quarries.	5									
Cycle of major disciplines University component												
15	Big data in geosciences	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							v		
16	Organization of topographic and geodetic works	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		v							v
17	Monitoring of deformation processes of buildings and structures	As a result of studying the subject, the undergraduate must master theoretical practical skills in measuring elevations of parts of	5				v					v

		buildings and structures; stress state in soil masses and structures of buildings and structures; horizontal movements of soil masses limited by slopes or slopes.										
18	Geospatial data visualization	Purpose: mastering the methods and concept of visual representation of spatial data (PD) obtained as a result of measurements for making managerial and engineering decisions. Contents: the study of geovisualization in the context of related disciplines; using modern approaches to visualization of geo-images and methods of PD representation. Interactive approaches to isosurface contouring for geovisualization are considered separately; multivariate mapping and classification; interpretation of spatial analysis results; modeling of virtual environments ("True 3D", empirical research, VR/AR).	4			v				v		
19	Three-dimensional object modeling in GIS	The discipline "Three-dimensional modeling of objects in GIS" includes the study of methods for creating, analyzing and visualizing three-dimensional models of objects using geographic information systems. Discusses 3D modeling principles, tools and their applications in various fields such as urban planning, architecture and ecology.	5						v	v		
20	Spatial Analysis	The discipline "Spatial Analysis" includes the study of methods for analyzing geographic data, visualization, statistics of spatial data, spatial modeling, the application of GIS in various fields and the acquisition of practical skills in working with software tools for analyzing spatial data.	5						v			
21	Organization of scientific research	The organization of scientific research based on the familiarization of undergraduates with	5					v				

		scientific knowledge, the formation of readiness and ability to conduct research activities related to the selection of necessary research methods, conducting experimental research and analyzing their results, based on modern achievements of domestic and foreign scientists and opens the way to the introduction of new developments.										
22	Remote sensing of the Earth and natural resources	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.	5			v				v		
23	Aerospace exploration of natural resources	Classification of natural resources. Scientific foundations of environmental monitoring. Aerospace monitoring systems. Space remote sensing tools of medium and high spatial resolution. High spatial resolution remote sensing radar equipment. Space monitoring of forest resources of the Republic of Kazakhstan. Monitoring forest and steppe fires. Satellite monitoring of rational use of land resources.	5			v				v		
Cycle of major disciplines Selectable Component												
24	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		v				v			
25	WEB-GIS	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,	5						v	v		

		Mapserver, Geoserver); geospatial web services, geoportals, meshes, mobile GIS, creating interactive online maps for solving problems in the field of geodesy, cartography, surveying.										

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 06.03.2025 Minutes №10

WORKING CURRICULUM

Academic year	**2025-2026 (Autumn, Spring)**
Group of educational programs	**M123 - "Geodesy"**
Educational program	**7M07306 - "Geospatial Digital Engineering"**
The awarded academic degree	**Master of Technical Sciences**
Form and duration of study	**full time (scientific and pedagogical track) - 2 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	4 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)													
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
LNG213	Foreign language (professional)		BD, UC	3	90	0/0/30	60	E	3				
HUM214	Psychology of management		BD, UC	3	90	15/0/15	60	E	3				
MAP709	Methods for creating and developing state geodetic networks	2	BD, CCH	5	150	15/0/30	105	E	5				
MAP201	Aerospace environmental monitoring	2	BD, CCH	5	150	30/0/15	105	E	5				MAP112
MNG782	Sustainable development strategies	2	BD, CCH	5	150	30/0/15	105	E	5				
MAP701	Innovative methods of engineering and geodetic works	3	BD, CCH	5	150	15/0/30	105	E	5				
MAP713	Spatial data infrastructure	3	BD, CCH	5	150	15/0/30	105	E	5				
MNG781	Intellectual property and research	3	BD, CCH	5	150	30/0/15	105	E	5				
HUM212	History and philosophy of science		BD, UC	3	90	15/0/15	60	E		3			
HUM213	Higher school pedagogy		BD, UC	3	90	15/0/15	60	E		3			
MIN220	Methodology of continuous career design in inclusive education	2	BD, CCH	5	150	30/0/15	105	E		5			
MNG783	Sustainable Business and Project Management	2	BD, CCH	5	150	15/0/30	105	E		5			
MAP728	Mathematical modeling of field indicators	2	BD, CCH	5	150	15/0/30	105	E		5			
MAP708	Technology for automating the land survey process	2	BD, CCH	5	150	15/0/30	105	E		5			
M-3.Practice-oriented module													
AAP273	Pedagogical practice		BD, UC	8				R				8	
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				
MAP716	Spatial analysis		PD, UC	5	150	15/0/30	105	E		5			
MAP238	Organization of scientific research		PD, UC	5	150	30/0/15	105	E		5			MAP138
MAP710	WEB-GIS	1	PD, CCH	5	150	15/0/30	105	E		5			

MAP712	Land management using WEB-GIS	1	PD, CCH	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		
MAP299	Aerospace exploration of natural resources		PD, UC	5	150	15:0:30	105	E			5		
MAP730	Geospatial data visualization		PD, UC	5	150	15:0:30	105	E			5		
MAP714	Three-dimensional object modeling in GIS		PD, UC	5	150	15:0:30	105	E			5		
MAP741	Remote sensing of the Earth and natural resources/		PD, UC	4	120	30:0:15	75	E			4		
M-3.Practice-oriented module													
AAP256	Research practice		PD, UC	4				R			4		
M-4. Experimental research module													
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R	4				
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R		4			
AAP251	Research work of a master's student, including internship and completion of a master's thesis		RWMS	2				R			2		
AAP255	Research work of a master's student, including internship and completion of a master's thesis		RWMS	14				R				14	
M-5. Module of final attestation													
ECA212	Registration and protection of the master thesis		FA	8								8	
Total based on UNIVERSITY:									30	30	30	30	
									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	15	35
PD	Cycle of profile disciplines	0	48	5	53
Total for theoretical training:		**0**	**68**	**20**	**88**
RWMS	Research Work of Master's Student				24
ERWMS	Experimental Research Work of Master's Student				0
FA	Final attestation				8
TOTAL:					**120**

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. 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 — Ryabekov K. .

Department Chair - Surveying and geodesy — Meirambek G. .

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