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

EDUCATIONAL PROGRAM
7M07306 - «Geospatial Digital Engineering»

Education Area code and classification: 7M07 Engineering Manufacturing and Civil engineering
Training area code and classification: 7M073 Architecture and Civil engineering
Group of educational programs: M123 Geodesy
NQF level: 7
ORC level: 7
Duration of training: 2 years
Amount of credits: 120

Almaty 2023

NJSC "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATPAYEV"

Educational program 7M07306 - «Geospatial Digital Engineering» was approved at a meeting of the Academic Council of KazNRTU named after.K.I. Satpayev.
Protocol № 11 of 28.03.2023
Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after. K.I.Satpayev.
Protocol № 11 of 28.03.2023

Educational program 7M07306 - «Geospatial Digital Engineering» developed by the academic committee in the direction of «Geospatial Digital Engineering»

Full name	Academic degree/ academic title	Position	Place of work	Signature
Chairman of the Academic Committee:				
Kochetova M.A.		director	«Leica Geosystems Kazakhstan»	
Academic staff:				
Orynbassarova E.O.	PhD	head of department	SU	
Kassymkanova Kh.M.	d.t.s	professor	SU	
Nukarbekova Zh.M.	m.s.c.	senior lecturer	SU	
Employer:				
Narbaev M.M.		director	TOO «ALIGeo»	
student:				
Erezhep G.T.		2nd year master's student		

F KazNRTU 703-05 Educational program

Table of contents

List of abbreviations and symbols

Table 1 - Used abbreviations

Abbreviation	Full name
ECTS	European Credit Transfer and Accumulation System
SU	NAO Satbayev university
MES RK	Ministry of Education and Science of the Republic of Kazakhstan
TS	Teaching staff
EP	Educational program
RO	Registrar's office
WC	Working curriculum of the EP

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 field of education	7M07 Engineering, manufacturing and Civil engineering
2	Code and classification of areas of study	7M073 Architecture and civil engineering
3	Group of educational programs	M123 Geodesy
4	Name of the educational program	7M07306 Geospatial Digital Engineering
5	Brief description of the 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	EP purpose	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	EP type:	New EP
8	Level on NQF	7
9	Level on SQF	7
10	EP distinctive features	No
11	List of competencies of the educational program:	9
12	The formed educational outcomes:	1. 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 2. Apply the skills of control systems, means of improving production efficiency and adapting modern information technologies to automate processes 3. Understand and apply the concepts of geospatial analysis, immersive technologies, and 3D visualization of aerospace and ground imaging techniques 4.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 5. 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 6. 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 7. 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 8. 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 9. Master theoretical and practical skills in conducting geodetic surveys to solve applied and scientific problems
13	Form of study	Daytime
14	Period of study	2 years
15	Volume of credits	120
16	Languages of education	Russian, Kazakh
17	The awarded academic degree	Master
18	Developer(s) 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 designed for undergraduates of technical specialties to improve and develop foreign language communication skills in professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies (round table, debates, discussions, analysis of professionally oriented cases, design). The course ends with a final exam. Undergraduates also need to study independently (MIS).	5								v	
2	History and philosophy of science	The subject of the philosophy of science, the dynamics of science, the specifics of science, science and prescience, antiquity and the formation of theoretical science, the main stages of the historical development of science, the features of classical science, non-classical and post-non-classical science, the philosophy of mathematics, physics, engineering and technology, the specificity of	3					v				

		engineering sciences, the ethics of science , social and moral responsibility of a scientist and engineer										
3	Higher school pedagogy	Undergraduates will master the methodological and theoretical foundations of higher school pedagogy, plan and organize the processes of teaching and upbringing, master the communicative technologies of subject-subject interaction between a teacher and a master in the educational process of a university.	3					v				
4	Psychology of management	The discipline studies the modern role and content of psychological aspects in managerial activity. The improvement of the psychological literacy of the student in the process of implementing professional activities is considered. Self-improvement in the field of psychology and studying the composition and structure of management activities, both at the local level and abroad. The psychological feature of modern managers is considered.	3					v				
Cycle of basic disciplines Selectable Component												
5	Aerospace environmental monitoring	Cartographical method - studying according to cards of structure, interrelations, dynamics and evolution of the phenomena in time and space, the forecast of their development,	5			v						

		receipt of various quality and quantity characteristics.										
6	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 for solving scientific and applied problems. The main content of the course contains the following sections: GNSS, absolute and relative survey methods, (kinematics and statics), post-processing and real-time processing; UAV and survey methods; laser scanning and methods of their shooting (VLS, MLS, NLS) when performing engineering survey, geodetic works.	5									v
7	Spatial Data Infrastructure	As part of the study of the discipline, the undergraduate will master the concepts of design and development of spatial data infrastructure, international and national standards for the implementation of SDI, database management systems, components of compatibility and exchange of multi-format data and their technical implementation in a GIS-oriented environment and geospatial services. The structures of data storage and their management, organization of access will be studied.	5							v		
8	Mathematical modeling of field indicators	The goal is to form the ability to apply mathematical modeling methods in describing the qualitative and	5						v	v		

		quantitative indicators of the deposit. 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 building models of deposit indicators and judging their adequacy; scientific approaches to modeling field indicators; fundamentals of mathematical thinking, the use of mathematical language.										
9	Methods for the creation and development of state geodetic networks	As part of the course, the undergraduate will master the principles and methodological approaches to the development, creation, modernization and use of the state geodetic network; organize the search, storage, processing, analysis of geodetic information from various sources for the modernization of the GGS, evaluate traditional and satellite methods for constructing the state geodetic network, classify the methods of conducting geodetic measurements at GGS points, consider issues related to the adjustment of geodetic networks and the coordination of networks built using the traditional method and satellite geodesy.	5				**v**					**v**
10	Technology for automating the land survey process	The aim of the course is to develop sustainable skills in the use of basic application software (GIS, CAD, office software and software for										

		scientific research) in solving production and scientific tasks.										
11	Visualization and processing of geospatial data	The discipline aims to master the methods and concept of processing and visual representation of spatial data (PD) obtained as a result of geodetic and surveying measurements for making managerial and engineering decisions and includes the following sections: geovisualization in the context of: points of view of related disciplines; geo-imaging; methods of visualization and representation of PD; interactive approaches to delineating the isosurface for geovisualization; multivariate mapping and classification; interpretation of spatial analysis results; Simulation of virtual environments ("True 3D", empirical research, VR/AR).	5				v					v
12	Aerospace exploration of natural resources	The purpose of the discipline is the development by undergraduates of modern achievements of aerospace technologies and means of studying natural resources, teaching them the basics of remote research, methods of analysis and decryption of aerial and satellite images.	5	v					v	v		
13	Monitoring the deformation processes of buildings and structures	The objectives of the course are the formation of practical and applied measurement skills: elevation marks of parts of buildings and structures; stress state in the soil mass and structures of	5					v	v			

		buildings and structures; horizontal movements of soil arrays bounded by slopes or slopes.										
14	Organization of scientific research	The discipline studies the concept of science, its role in the world; essence and organization of scientific research, their types; organization of research work at the university; criteria for substantiating the topic of scientific research, types of information sources, structure of research work, content of scientific search.	5					v				
15	Organization of topographic and geodetic works	The discipline aims to master the knowledge and skills in organizing topographic and geodetic works, using modern methods and techniques to solve applied problems in production and scientific research. The main content of the discipline includes the following sections: planning topographic and geodetic works, budgeting and calculating the costs of organizing and eliminating work during geodetic surveys, organizational and legal forms of enterprises, fixed assets of an enterprise, labor productivity, the basics of labor rationing.	5		v							v
16	Spatial Analysis	Spatial analysis allows you to solve complex location-oriented problems, find patterns, evaluate trends and make decisions. The tasks of the discipline include the development of the theory of spatial analysis, the main theoretical	5						v			

		aspects of constructing geographic images and the features of solving model problems, methods of spatial analysis for various design stages and research tasks. Master student will master the role of the spatial factor; prepare for research activities related to the study and numerical description of natural phenomena distributed in space; learn how to model spatial data.										
17	Three-dimensional object modeling in GIS	The course is aimed at studying 3D models used to solve scientific and practical problems, basic approaches to modeling geometric objects, 3D geoinformation modeling methods, requirements for the accuracy of building 3D models, as well as solving applied problems for the development of large-scale three-dimensional models of cities and objects based on data obtained from laser scanning, UAVs, remote sensing and classical methods geodetic surveys.	5		v					v		
18	Big data in geosciences	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; describe the concept of using big data in geosciences; use the basic capabilities of the tool for downloading and visualizing big data; solve the problems of processing raw data	5						v	v		

		received from different sources; apply intelligent data processing technologies; process data; ensure data security, be able to use alternative tools for big data analytics.										
19	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 in the amount provided for by the curriculum and necessary for solving production and research tasks using WEB-GIS technologies	5		v				v			
20	WEB-GIS	The discipline is focused on the formation of ideas and understandings about the concepts and technical foundations of web GIS; studying the possibilities of web GIS technologies on the example of ESRI products (ArcGIS online, server) and on the example of open resources (QGIS, Mapserver, Geoserver); geospatial web services, geoportals, mashups, mobile GIS, creation of interactive online maps for solving problems in the field of geodesy, cartography, mine surveying	5						v	v		

5. Curriculum of the educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kazakh named after K.I. Satpayev
M.Zh. Begentaev
"12" 12 2023y.

CURRICULUM
of Educational Program on enrollment for 2023-2024 academic year

Educational program 7M07306- "Geospatial digital engineering"
Group of educational programs M123 - "Geogeziy"

Form of study: full-time **Duration of study: 2 year** **Academic degree: Master of Technical Sciences**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters			
								1 course		2 course	
								1 semester	2 semester	3 semester	4 semester
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	E	5			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	E		3		
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	E		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E	3			
component of choice											
MAP709	Methods for creating and developing state geodetic networks	BD CCH	5	150	1/0/2	105	Э		5		
MAP201	Aerospace environmental monitoring				2/0/1						
MAP713	Spatial data infrastructure	BD CCH	5	150	1/0/2	105	Э	5			
MAP701	Innovative methods of engineering and geodetic works				1/0/2						
MAP728	Mathematical modeling of field indicators	BD CCH	5	150	1/0/2	105	Э	5			
MAP708	Technology for automating the land survey process				1/0/2						
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (university component, component of choice)											
MAP717	Big data in geosciences	PD	5	150	1/0/2	105	Э	5			
MAP258	Organization of topographic and geodetic works	PD	5	150	1/0/2	105	Э	5			
MAP716	Spatial analysis	PD	5	150	1/0/2	105	Э		5		
MAP271	Monitoring the deformation processes of buildings and structures	PD	5	150	1/0/2	105	Э			5	
MAP299	Aerospace exploration of natural resources	PD	5	150	1/0/2	105	Э			5	
MAP714	Three-dimensional object modeling in GIS	PD	5	150	1/0/2	105	Э			5	
MAP290	Visualization and processing of geospatial data	PD	5	150	1/0/2	105	Э			5	
MAP238	Organization of scientific research	PD	5	150	2/0/1	105	Э			5	
MAP710	WEB-GIS	PD	5	150	1/0/2	105	Э		5		
MAP712	Land management using WEB-GIS				1/0/2						
M-3. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6						6		
AAP256	Research practice	PD, CCH	8								8
M-4. Experimental research module											
AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	2					2			
AAP241	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	3						3		
AAP254	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	5							5	
AAP255	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	14								14
M-5. Module of final attestation											
ECA212	Preparation and defense of a master's 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		
		university component (UC)	component of choice (CCH)	Total
BD	Cycle of basic disciplines	20	15	35

PD	Cycle of profile disciplines				53
	Total for theoretical training:	*0*	*20*	*15*	*88*
	RWMS				*24*
FA	Final attestation	8			8
	TOTAL:	**8**	**20**	**15**	**120**

Decision of the Academic Council of Kaznu named after K.Satpayev. Protocol № 3 27.10.2022 y.

Decision of the Educational and Methodological Council of Kaznu named after K.Satpayev. Protocol № 2 21. 10. 2022 y.

Decision of the Academic Council of the Institute_____. Protocol № 2 от "11" 10 2022 y.

Vice-Rector for Academic Affairs **B.A.Zhautikov**

Director Mining and Metallurgical Institute named after O.Baikonurov **K.B. Rysbekov**

Head of the Department " Mine surveying and geodesy" **E. O. Orynbassarova**

Specialty Council representative from employers **A.T.Aimenov**