Institute of Automation and Information Technologies
Department of Electronics, Telecommunications and Space Technologies

Educational program
7M07138 «Space engineering and technology»

Code and classification of the field of education: 7M07 Engineering, manufacturing and construction industries
Code and classification of training directions: 7M071 Engineering and engineering business
Group of educational programs: M107 Space engineering
Level based on NQF: 7
Level based on IQF: 7
Study period: 2 years
Amount of credits: 120 credits

Алматы 2023

Образовательная программа 7М07138 «Космическая техника и технологии» утверждена на заседании Учёного совета КазНИТУ им. К.И.Сатпаева.
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Образовательная программа 7М07138 «Космическая техника и технологии» разработан академическим комитетом по направлению «М107 Космическая инженерия».

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List of abbreviations and designations

NAO KazNRTU named after K.I.Satpayev - Non-profit joint stock company «Kazakh National Research Technical University named after K.I. Satbayev»
SCSE – The State compulsory standard of education of the Republic of Kazakhstan;
MS&HE RK – Ministry of Science and Higher Education of the Republic of Kazakhstan;
EP – educational program;
IWS – independent work of a student (student, undergraduate, doctoral student);
IWST – independent work of a student with a teacher (independent work of a student (undergraduate, doctoral student) with a teacher);
WC – working curriculum;
SS – space systems
CED – catalog of elective disciplines;
SE&T – space engineering and technology
RSE – remote sensing of the Earth
UC – a university component;
CC – a component of choice;
NQF – National Qualifications framework;
IQF – industry qualifications framework;
LO – learning outcomes;
KC – key competencies.

1 Description of educational program:

The professional activities of graduates of the program cover the field of space engineering and, in particular, space systems for remote sensing of the Earth (CS remote sensing), aerospace monitoring.

The purpose of the educational program is to train highly qualified undergraduates based on the integration of education and science of an effective training system for scientific, scientific and pedagogical personnel of a new formation capable of solving issues of improving society, science and the development of new technologies in space engineering.

To this end, the student takes a course of theoretical training and exercises significant relevance and practical significance. The results of the research are presented in the form of a master's thesis, which is defended in accordance with the established procedure

In case of successful completion of the full master's degree course, the graduate is awarded the academic degree "Master of Technical Sciences" in the field of space systems for remote sensing of the Earth.

The educational program of the master's degree 7M07138 – "Space engineering and Technology" differs from the existing educational program in the specialty 6M074600 – "Space Engineering and Technology" by a complete update of the internal content of the disciplines. It provides training for undergraduates in the specialization of space engineering, which is most in demand in the domestic economic economy – space remote sensing systems (design, development of remote sensing systems and work with geospatial data on satellite images for sectors of the economy). This is due to the need to deepen knowledge and skills to expand the range of space technology tasks for the real economy. The modern needs of macro and microeconomics require graduates not only to have knowledge in exact and applied sciences in their chosen field of science, but also to understand the mechanisms and tools for implementing their ideas in production. The OP corresponds to the unified state policy of socio-economic development of the country using space technologies, which daily expand the scope of implementation and effective use of the national scientific, technological and human resources potential of the republic. The Master's Degree program provides for further deepening of the competencies acquired in the bachelor's degree.

The content of the Master's degree program consists of:

1) theoretical training, including the study of cycles of basic and core disciplines;

2) practical training of undergraduates: various types of practices, scientific or professional internships;

3) research work, including the completion of a master's thesis for a scientific and pedagogical master's degree;

4) final certification.

Graduates of the educational program of the *scientific and pedagogical master's* degree in Space Engineering and Technology can perform the following types of professional activities: design, production and technological, organizational and managerial, research and teaching in the space and related industries.

Objects of professional activity. The objects of professional activity of graduates of the master's degree in EP SE&T are enterprises of the aerospace industry and not only, as well as enterprises that will actively use the results of space activities, for example, remote sensing for daily activities, monitoring, analysis and forecasting of oil and gas, geodetic, agricultural and other industries. Also, the objects of professional activity are branch research and design institutes, branch laboratories, higher and secondary vocational educational institutions, government authorities and organizations of various organizational and legal forms.

Types and subjects of professional activity.

The subjects of *professional activity* are technological processes of digital processing of telecommunication signals, as well as digital signal processing in space communications, technologies for creating geoinformation systems in remote sensing, solving inventive tasks in the space industry based on TRIZ, methods of aerospace environmental monitoring, fundamentals of optical and radar remote sensing systems, methods and tools of digital photogrammetry and fundamentals of project management of infrastructure space industry projects, innovation management.

2. The purpose and objectives of the educational program

The goal of EP 7M07138 - «Space Engineering and Technology» is:

– formation of personnel for an innovative economy based on remote sensing space systems, covering modern space technologies, design activities, innovative solutions, entrepreneurship in the high-tech field of using the results of space activities of the republic.

Tasks of EP 7M07138 - «Space Engineering and Technology» is:

– study of a cycle of general education disciplines to provide social and humanitarian education based on the laws of socio-economic development of society, history, the state language, Russian and foreign languages, modern information technologies;

– the study of a cycle of basic disciplines for obtaining natural science, general technical and economic knowledge as the foundation of professional education;

– study of a cycle of core disciplines for the formation of theoretical knowledge, practical skills and abilities to use for process management in engineering telecommunications systems, as well as in infocommunication systems;

– acquisition of skills and abilities to perform technical calculations and substantiate design solutions in remote sensing space systems using modern computer technologies and intelligent programs;

– study of disciplines that form knowledge, skills and abilities of planning and organizing theoretical, experimental and laboratory research;

– familiarization with technical processes, systems for the organization of innovation management, planning and management of the development of new equipment and technology for the space industry based on research internships of a graduate student.

The duration of the master's degree is determined by the amount of academic

credits acquired. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the Master's degree program is considered to be fully mastered. The scientific and pedagogical master's degree program has at least 120 academic credits for the entire period of study, including all types of educational and scientific activities of a graduate student.

The planning of the content of education, the way of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of credit technology of education.

The content of the educational program (EP) "SE&T" is implemented in accordance with the credit technology of education and is carried out in the state, Russian languages.

3. Requirements for evaluating the learning outcomes of an educational program

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admission of citizens to the master's degree is established in accordance with the "Standard rules for admission to study in educational organizations implementing educational programs of postgraduate education."

The formation of a contingent of undergraduates is carried out through the placement of a state educational order for the training of scientific and pedagogical personnel, as well as tuition fees at the expense of citizens' own funds and other sources. The State provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive education at this level for the first time.

At the "entrance", the undergraduate must have all the prerequisites necessary to master the appropriate educational program of the master's degree. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a paid basis.

A graduate of the scientific and pedagogical master's degree should:

have an idea:

- on the role of science and education in public life;
- about current trends in the development of scientific knowledge;
- on current methodological and philosophical problems of natural sciences;
- on the professional competence of a high school teacher;
- on the contradictions and socio-economic consequences of globalization processes;
- about the latest discoveries in the chosen field of activity, the prospects of their

to use:

- for building space systems and technologies for them;

- on mathematical and physical modeling of systems in the field of development and processing of remote sensing of the Earth;
- on design, research, inventive, innovative activities in the field of space technology for applied economic problems.
- about the possibilities of advanced scientific methods and technical means, to use them at the level necessary for the study of satellite images.

to know:

- methodology of scientific knowledge;
- principles and structure of the organization of scientific activity;
- psychology of cognitive activity of students in the learning process;
- psychological methods and means of improving the effectiveness and quality of education;
- international and domestic standards, regulations, orders, orders of higher-level and other domestic organizations, methodological normative and guidance materials related to the work performed;
- current state and prospects of technical and technological the development of technology and technology in the space industry, the activities of industry institutions, organizations, enterprises and related industries and their features;
- standards in the field of quality management and project management;
- achievements of science and technology, advanced domestic and foreign experience in the application of space technology in various fields of economics.
- at least one foreign language at a professional level, allowing for scientific research and practical activities;
- the methodology of conducting all types of training sessions and independent work of students.

to be able to:

- process data using planning techniques, regression and correlation analysis, and digitalization methods;
- to carry out measures for the organization of production in accordance with regulatory documents;
- to use the acquired knowledge for the original development and application of ideas in the context of scientific research;
- critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena;
- integrate knowledge gained in different disciplines to solve research problems in new unfamiliar conditions;
- by integrating knowledge, make judgments and make decisions based on incomplete or limited information;
- apply the knowledge of pedagogy and psychology of higher education in their teaching activities;
- apply interactive learning methods;
- to carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- think creatively and be creative in solving new problems and situations;
- be fluent in a foreign language at a professional level, which allows conducting

scientific research and teaching special disciplines in universities;

- summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc.;

have to the skills:

- scientific research activities, solving standard scientific problems;
- implementation of educational and pedagogical activities on credit technology of education;
- methods of teaching professional disciplines;
- the use of modern information technologies in the educational process;
- professional communication and intercultural communication;
- oratory, correct and logical presentation of their thoughts in oral and written form;
- expanding and deepening the knowledge necessary for daily professional activities and continuing education in doctoral studies.

to be competent:

- in the field of research methodology;
- in the field of scientific and scientific-pedagogical activity in higher educational institutions;
- in matters of modern educational technologies;
- in the implementation of scientific projects and research in the professional field;
- in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

B - Basic knowledge, skills and abilities

B1 - To know the history and philosophy of science, pedagogy and psychology;

B2 - The ability to independently apply methods and means of cognition, learning and self-control to acquire new knowledge and skills, including in new areas that are not directly related to the field of activity.

B3 - To speak the state language, Russian and one of the most common foreign languages in the industry at the level that ensures human communication.

B4 - Be able to use fundamental general engineering knowledge, the ability to practically use the basics and methods of mathematics, physics and chemistry in their professional activities.

B5 - Proficiency in professional terminology and the ability to work with educational and scientific materials in the specialty in the original in a foreign language. The ability to logically correctly, argumentatively and clearly build oral and written speech.

B6 - General engineering skills.

B7 - Possession of fundamental knowledge on the theory of solving inventive tasks in the space industry;

B8 - Basic knowledge on the basics of processing space signals of remote sensing of the Earth and control of elements of space systems.

B9 - Possession of modern and promising technologies for the creation of space technology and technology.

B10 - To know and master the basic business processes of developing a telemetric information and communication system in remote sensing tasks,

B11 - The ability to conduct pedagogical work using modern techniques and

technologies.

P - Professional competencies

P1 - a wide range of theoretical and practical knowledge in professional activities in structures and organizations using space technology;

P2 is ready to participate in the development and design of new innovative technologies and equipment for automation of infocommunication remote sensing systems

P3 - Have the skills to draw up electronic technological circuits for digital processing tasks

P4 - Possess the skills to carry out design, technological, and energy calculations of CS .

P5 - Be able to calculate and select the main and auxiliary equipment

P6 - Be able to develop and select drawings of equipment, buildings and structures

P7 - Be able to draw up a business plan for a technological project

P8 - Be able to process satellite images in several ways

P9 - Be able to develop measures to protect the environment in the development of innovative projects

P10 - Be able to conduct a literary search, compile reports, reviews, conclusions, etc., choose research methods, plan and conduct necessary experiments, analyze and summarize research results, issue patents

P11 - The ability to use the knowledge, skills, and skills acquired in the course of training to develop a methodology for conducting research related to the professional field and organize experiments with the analysis of their results

P12 - Possess practical skills in the field of independent organization and management of scientific research on a scientific topic

P13 - The ability to apply knowledge, skills, and skills acquired in the process of studying under the Master's degree program.

U - Universal, social and ethical competencies

U1 - is able to use English fluently as a means of business communication, a source of new knowledge in the field of automation or robotization of production processes. I am ready to use English in my professional activities in the field of enrichment and metallurgy;

U2 is able to speak Kazakh (Russian) fluently as a means of business communication, a source of new knowledge in the field of automation or robotization of production processes. I am ready to use the Kazakh (Russian) language in my professional activities in the field of enrichment and metallurgy;

U3 - to know and apply the basics of applied ethics and ethics of business communication in work and life;

U4 - to know and apply the basic concepts of professional ethics;

U5 - to know and solve the problems of human influence on the environment.

S - Special and managerial competencies

S1 - independent management and control of the processes of labor and educational activities within the framework of the strategy, policy and goals of the organization, discussion of problems, argumentation of conclusions and competent information management;

S2 - to be a specialist in conducting experimental studies of ore processing facilities and metallurgy;

S3 - to be a researcher, a specialist in scientific research of ore processing facilities and objects of finished metal-containing products;

S4 - to be an engineer for the development and design of processing and metallurgical workshops, factories, production lines.

4 Passport of the educational program

4.1 General information

№	Field name	Note
1	The code and classification of the field of education	7M07 Engineering, manufacturing and construction industries
2	The code and classification of training areas	7M071 Engineering and Engineering business
3	Group of educational programs	M107 Space Engineering
4	Name of the educational program	7M07138 «Space engineering and technologies»
5	A brief description of the educational program	The educational program 7M07138 "Space engineering and technologies" involves the training of highly qualified specialists in the field of space technologies, Space systems for Remote Sensing of the Earth and satellite navigation.
6	The purpose of the EP	The purpose of the educational program is to train undergraduates in basic and specialized disciplines with the achievement of appropriate competencies in the field of remote sensing.
7	Type of EP	New
8	The level based on NQF	Level 7 – higher education and practical experience
9	The level based on IQF	Level 7 – A wide range of special (theoretical and practical) knowledge (including innovative). Independent search, analysis and evaluation of professional information
10	Distinctive features of the EP	No
	Partner University (Joint educational programs)	No
	Partner University (Double degree educational program)	No
11	Learning outcomes of the EP	LO1 - have fundamental scientific and professional training, have knowledge of modern social and political problems, speak state and foreign languages, tools of the market economy LO2 - know the organizational forms and principles of the learning process and pedagogical control, apply knowledge of pedagogy and psychology of higher education, management psychology in professional, scientific and pedagogical activities. LO3 - to possess modern information and communication technologies, including methods of obtaining, processing and storing scientific information, to apply interactive teaching methods. LO4 - to determine the most relevant directions for the development of space systems and methods of remote sensing of the Earth, to be able to analyze and monitor modern problems of the development of space technology and technology, as well as to make management decisions

		based on their results, to develop energy- and resource-saving technologies in the field of applied and scientific tasks of the space industry. LO5 - to have the skills and abilities to work on modern scientific equipment, auxiliary equipment and instrumentation, to develop a digital signal processing circuit and the design of an experimental installation, to carry out its installation and debugging. LO6 - conduct experimental studies of technological processes, space systems and the results of space activities, process digital data using planning techniques, regression and correlation analysis and intelligent systems, develop mathematical and simulation models of Earth sensing processes. LO7 - to know the regulatory and technological documentation of production, the requirements of national and international standards, safety and environmental protection, to carry out measures to protect the environment in production. LO8 - demonstrate methods of scientific work, professionally participate in scientific discussions, summarize the results of research and analytical work in the form of a dissertation, scientific article, patents, report, analytical note and other materials. LO9 - have professional knowledge in the field of space project management, GIS data, automation and robotization of remote sensing systems and innovative management LO 10 – to have knowledge on solving technical contradictions, laws of development of technical systems using TRIZ information resources.
12	The form of education	Full-time
13	The duration of the education	2 years
14	Language of education	Kazakh/russian
15	Amount of credits	120 credits
16	Academic degree awarded	Master of Engineering and Technology in the educational program 7M07138 "Space Engineering and Technology"
17	Academic degree awarded	Master of Technical Sciences
18	Developer(s) and authors:	Tashtay E., Zhunusov K.H.

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

№	Name of the discipline	A brief description of the discipline	Number of credits	Generated learning outcomes (codes)									
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10
The cycle of basic disciplines The university component													
1	English (professional)	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in the professional and academic field. 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**	**V**	**V**							
2	Management Psychology	The course is aimed at teaching undergraduates the basics of management psychology. It will consider the specifics of management psychology, psychological patterns of managerial activity, personality and its potential in the management system; motivation and effectiveness in the organization, leadership and leadership in modern management of organizations, a social group as an object of management, psychological foundations of managerial decision-making, business communication and managerial conflicts, psychology of responsibility, image creation, how an integral part of the culture of communication, the psychology of advertising.	3	**V**	**V**	**V**							
3	History and philosophy of science	The subject of philosophy of science, dynamics of science, specifics of science, science and pre-science, antiquity and the formation of theoretical 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**	**V**	**V**							
4	Higher school pedagogy	The course is intended for undergraduates of the scientific and pedagogical master's degree in all specialties. As part of the course, undergraduates will master the methodological and theoretical foundations of higher school pedagogy, learn how to use modern pedagogical technologies, plan and organize learning and upbringing processes, master the communicative technologies of subject-subject	3	**V**	**V**	**V**							

		interaction between a teacher and a graduate student in the educational process of a university. Undergraduates also study human resource management in educational organizations (using the example of higher education).											
5	Teaching practice	Pedagogical practice (PP) is an essential component and an integral part of the educational process of undergraduates. The purpose of the PP is the general professional training of undergraduates for teaching at a university. The objectives of the pedagogical practice of undergraduates are to consolidate the knowledge, skills and abilities acquired by undergraduates in the process of studying the disciplines of the master's program. Pedagogical practice is conducted at the graduating department, which trains masters. The terms and duration of the internship are set in accordance with the curricula and the calendar schedule of the educational process. During the internship period, undergraduates are subject to the internal regulations of the university.	6	**V**	**V**	**V**					**V**		
The cycle of basic disciplines Component of choice													
6	Intelligent micro and nanosensory devices	Functional schemes of simple and intelligent sensors, their classification is given. Various types of mechanical, acoustic, electrical, electromagnetic, electrochemical and optical simple and intelligent sensors are considered, and the physical principles of their operation are explained. The approaches to the design of intelligent sensors are described, the principles of construction and the most important technical characteristics of their main structural components are disclosed, and methods for selecting useful signals are described. The directions of further development of intelligent sensors are outlined.	5					**V**	**V**				
7	Computer vision	The Computer Vision discipline is an interdisciplinary course covering image processing technologies and techniques for computer systems. Master's degree students delve into pattern recognition algorithms, image analysis and interpretation using artificial intelligence and machine learning. The main focus is on the application of computer vision in various fields such as medicine, robotics, autonomous vehicles and many others, which allows students to master in-demand skills in the industry and learn how to solve practical problems in the field of image processing.	5				**V**	**V**	**V**				
8	Wireless digital data transmission networks	Classification and characteristics of wireless networks. Access methods in local Wi-Fi wireless networks. Time, frequency, code, and spatial	5					**V**	**V**				

		methods of access separation in IEEE 802.11 networks. MAC layer of the IEEE 802.11 standard. Organization of physical and channel layers. Spectrum expansion technology and radio signal modulation methods. DSSS spectrum extension technology. Methods of generating information symbols. BPSK and QPSK modulations. Ways to expand the signal spectrum. Barker's code. Ways to convert data into a modulation symbol. Modulation methods OBPSK, OQPSK, DBPSK, DQPSK. QAM modulation, data representation on a signal constellation. CCK is a method of encoding and protecting information. Walsh codes and the Hadamard matrix. Orthogonal codes. PBCC is a method of encoding and protecting information. Construction of dotted and ultra-precise encoders. OFDM modulation based on Fourier transforms. Forward and reverse Fourier transform for transmitting/receiving information symbols. Ultra-wideband pulse networks. A method for generating and transmitting/receiving information symbols based on broadband pulse coding. Ultra-high-speed wireless networks. Wi-Fi networks of 802.11.xx standards. Architecture, protocols, characteristics of Wi-Fi networks of 802.11b, s, xxx standards.												
9	Theory of solving inventive tasks in the space industry	The discipline is designed to solve problems arising in the development, design and operation of new innovative equipment and technologies in the space industry. The study of the main stages of the development of technical characteristics of small and large rocket and space technology, spacecraft and methods of remote sensing of the Earth. The evolutionary development of technical systems always encounters contradictions and complex technical solutions. The objective of the course is to reveal the laws of the development of technical systems and methods for solving the set engineering tasks for the space industry.	5											**V**
10	Innovative management	After successful completion of the discipline, undergraduates will gain knowledge about the key components of project management, with an emphasis on modern behavioral models of project-oriented business development management. The course program is based on the international standards PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management recognized by the business community. The features of organizational management of business development through projects in the relationship of strategic, project and operational management are studied. The system of practices, methods and procedures used in the innovative	5							**V**			**V**	**V**

		activities of organizations is considered, taking into account the psychological aspects of team building, communication and interaction with stakeholders.											
THE CYCLE OF CORE DISCIPLINES (CD)													
11	Technology of digital processing of telecommunication signals	Basic concepts of physical quantity, measurement and signal conversion. Signal classification: deterministic and random signals, continuous, discrete and quantized signals. Types of deterministic signals, their parameters. Single pulse, constant signal, harmonic and polyharmonic signals. Decomposition of a periodic signal into a Fourier series. The spectrum of the signal. Non-periodic (transient) signals. Fourier transform for transient signals. Analog systems. Impulse and transient characteristics. The transmission coefficient.	5					**V**	**V**	**V**			
12	Fundamentals of geoinformation systems in remote sensing	The discipline "Fundamentals of geoinformation systems in remote sensing" is a course aimed at studying the basic principles and methods of using geoinformation systems (GIS) in remote sensing of the Earth (remote sensing). Master's degree students will gain an understanding of the theoretical foundations of GIS, their structure, functions and applications in the analysis of geospatial data. The course also covers methods for processing and analyzing satellite images, visualizing results, and using GIS in various fields such as ecology, geology, geodesy, and urban planning. This provides students with the necessary skills to solve problems of geoinformation analysis and prepares them for work in the field of geospatial technologies.	5							**V**	**V**	**V**	
13	Digital signal processing in space communications	The discipline "Digital Signal Processing in space communications" is a course dedicated to signal processing methods and technologies used in space communication systems. Master's degree students delve into the basic principles of analysis and processing of radio signals used in space communications, as well as study modern digital processing methods to improve the efficiency of data transmission in the space environment. The course also covers satellite communications, radio navigation and signal processing in conditions of noise and distortion, which allows students to acquire competencies for work in the field of space engineering and communications.	5					**V**		**V**			
14	Remote sensing data banks in the global network	The discipline "Remote sensing data banks in the global network" is a course aimed at studying the basic principles of organizing, accessing and analyzing data obtained from remotely sensed terrestrial surfaces in	5				**V**	**V**	**V**				

		the context of their storage and processing in a global computer network. Master's degree students delve into the technologies of processing and interpreting geospatial data provided by remote sensing, and study methods of accessing this data through Internet resources and databases. The course also includes practical skills in working with geoinformation systems and remote sensing data analysis using various software tools, which allows students to successfully apply their knowledge in professional activities in the field of geoinformatics and geoinformation systems.											
15	Aerospace environmental monitoring	The discipline "Aerospace Environmental Monitoring" is designed to study the principles and methods of using aerospace technologies in environmental monitoring. Undergraduates delve into the application of satellite data and remote sensing to analyze and monitor various environmental parameters, including climate change, air and water pollution, soil degradation and other environmental aspects. The course also covers practical aspects of data processing and interpretation, which allows students to develop skills and competencies for work in the fields of ecology, geoinformatics and aerospace technologies.	5							**V**			
16	Geoinformation technologies for environmental monitoring	The discipline "Geoinformation technologies for environmental monitoring" is designed to study modern methods and tools for using geoinformation systems in environmental monitoring. Master's degree students delve into the application of geospatial analyses, satellite data processing, and cartography to track and analyze various aspects of the environment, such as changes in the Earth's surface, vegetation distribution, pollution levels, and more. The course also includes practical classes on working with software tools for geoinformation data processing, which allows students to acquire skills for the effective application of geoinformation technologies in the field of environmental protection and sustainable development.	5								**V**		
17	Telemetry infocommunication systems	The study of the principles of building radio telemetry complexes and systems, methods of transmitting telemetry information, increasing the noise immunity of telemetry data transmission channels, and setting standards in the design of modern telemetry systems.	5				**V**		**V**				
18	Deep learning of robots	The discipline "Deep Learning of robots" is a course aimed at studying advanced machine learning methods used in the field of robotics. Undergraduates immerse themselves in deep learning concepts and algorithms such as neural networks and convolutional neural networks	5									**V**	**V**

		and explore their applications for autonomous navigation, object recognition, motion planning and other robotics tasks. The course includes both the theoretical foundations of deep learning and practical classes on programming and configuring robots using modern machine learning tools and libraries.											
19	Fundamentals of optical and radar remote sensing systems	The discipline "Fundamentals of optical and Radar remote sensing systems" is a course dedicated to the study of the principles and technologies underlying optical and radar systems for remote sensing of the Earth (remote sensing). Undergraduates will get acquainted with the basics of the functioning of optical systems such as multispectral and hyperspectral equipment, as well as radar systems used to obtain information about the Earth's surface from space. The course includes both theoretical and practical aspects, allowing students to deepen their knowledge and skills in the field of processing and analyzing data obtained using optical and radar remote sensing systems.	5						**V**	**V**			
20	Internet of Things self-organizing networks	Self-organizing networks, familiarization with the concept of the Internet of Things, pervasive sensor networks, wireless self-organizing networks and self-organizing networks for vehicles, as well as an overview of the main protocols for controlling access to the transmission medium, routing and transport layer. A network with a variable topology. Dynamic. Decentralized. Mobile. Nodes that make up the network. These can be personal computers, laptops, smartphones, tablets, smart sensors and other devices.	5				**V**		**V**				
21	Multi-channel RTSs for information transmission	The course covers the following main sections: Principles of radio communication. Classification of radio wave ranges. Elements of the theory of radio wave propagation. Features of electromagnetic wave propagation. Different ranges. Features of the radio communication system. Continuous message transmission radio systems. The differential entropy of a continuous signal. The bandwidth of the communication channel when transmitting continuous signals. Characteristics of communication channels and paths.	5								**V**	**V**	
22	Digital photogrammetry	The discipline "Digital Photogrammetry" is a course aimed at studying the principles and methods of processing photographs and images in order to obtain accurate geospatial information. Master's degree students delve into topics such as three-dimensional modeling, creation of digital elevation models, analysis and interpretation of images for geodetic and cartographic purposes. The course also includes practical classes where	5					**V**	**V**				

		students master photogrammetric analysis software, which allows them to develop skills for work in the fields of geodesy, cartography, geoinformation systems and architecture.											
23	Project management	The discipline "Project Management" is a course focused on the study of the basic principles and methods of project management. Master's degree students delve into understanding the project lifecycle, resource planning and control, stakeholder communication and risk management. The course also includes case analysis and practical exercises that will allow students to acquire the skills necessary for successful project management in various areas of business and industry.	5									**V**	**V**
24	Space-based remote sensing radar systems	The discipline "Space-based remote sensing radar systems" is a course aimed at studying the principles and technologies of radar systems used in space-based remote sensing of the Earth. Undergraduates delve into the main aspects of radar operation on board spacecraft, including signal generation and processing, as well as interpretation of radar data for analyzing the Earth's surface and its environment. The course also covers current topics such as radar tomography and data processing algorithms, providing students with the necessary knowledge and skills to work with radar systems in a space environment.	5					**V**			**V**		
25	Photogrammetry methods	The discipline "Photogrammetry Methods" is a course dedicated to the study of techniques and principles for creating three-dimensional models of objects based on photographs and images. Master's degree students master the methods of processing and analyzing photographic data, including the creation of digital high-altitude models, as well as the assessment of the sizes and shapes of objects on the earth's surface. The course also covers the application of photogrammetry in various fields, including geodesy, architecture, urban planning and archaeology.	5						**V**	**V**			
26	Research practice	Research practice (IP) is a form of professional training of undergraduates for scientific and pedagogical activities, which is a type of practical activity of undergraduates related to conducting scientific research within the framework of the chosen topic of the dissertation, preparing scientific publications, final scientific qualification work (dissertation) and its subsequent defense. Research practice is a component of the main professional educational programs of the Master's degree. The purpose of research practice is to develop undergraduates' skills and abilities to conduct qualified scientific research in their chosen field, use scientific methods in conducting	8				**V**	**V**					

		research, analyze, summarize and use the results obtained. The content of the research practice is determined by the work program of the practice, taking into account the specifics of the orientation of training determined by the department, to which the conditions for conducting scientific research practice are attached.											

5. The working curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVE
Chairman of the Board-
Rector of the NTU named after K. Satpaeva
A.S. Begentaev
2022

CURRICULUM
EDUCATIONAL PROGRAM for recruitment for 2023-2024 academic year, full-time

Educational program 7M07138 - "Space equipment and technologies"
Group of educational programs 7M107 - "Space engineering"

Form of study: full-time | Duration of study: 2 years | Academic degree: master of technical sciences

Discipline code	Name of disciplines	Cycle	Total volume in credits	Total hours	Audience volume lek/lab/pr	SRO (including SROP) in hours	form of control	Distribution of classroom studies by			
								1 course		2 course	
								1 semester	2 semester	3 semester	4 semester
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Basic training module (university component)											
LNG210	English (professional)	DB VK	5	150	0/0/3	105	E	5			
HUM214	Psychology of management	DB VK	3	90	1/0/1	60	E		3		
HUM212	History and philosophy of science	DB VK	3	90	1/0/1	60	E		3		
HUM213	Pedagogy of higher education	DB VK	3	90	1/0/1	60	E	3			
M-2. digital signal module											
ELC264	Intelligent micro and nanosensor devices	BD KV	5	150	2/0/1	105	E	5			
ELC233	Organization of research and development										
CSE747	computer vision	BD KV	5	150	2/0/1	105	E	5			
ELC295	Wireless digital data networks										
ELC282	The theory of inventive problem solving in the space industry	BD KV	5	150	2/0/1	105	E			5	
NSE173	Innovation management										
CYCLE OF PROFILING DISCIPLINES (PD)											
M-3. Profile training module (university component and elective component)											
ELC288	Technology of digital processing of telecommunication signals	PD VK	5	150	2/0/1	105	E	5			
ELC283	Fundamentals of geoinformation systems in remote sensing	PD VK	5	150	2/0/1	105	E	5			
ELC289	Digital signal processing in space communications	PD VK	5	150	2/0/1	105	E		5		
MAP107	Remote sensing data banks in the global network	PD VK	5	150	2/1/0	105	E			5	
MAP300	Aerospace environmental monitoring	PD KV	5	150	2/0/1	105	E			5	
MAP315	Geoinformation technologies for environmental monitoring										
ELC213	Telemetric infocommunication systems	PD KV	5	150	2/0/1	105	E		5		
MAP259	Deep learning robots										
ELC227	Fundamentals of optical and radar remote sensing systems	PD KV	5	150	2/0/1	105	E		5		
ELC253	Internet of things self-organizing networks										
ELC221	Multi-channel RTS information transmission	PD KV	5	150	2/0/1	105	E			5	
MAP222	Digital photogrammetry										
MNG705	Project management										
ELC277	Space-based remote sensing radar systems	PD KV	5	150	2/0/1	105	E			5	
ELC278	Photogrammetry methods										
M-4. Practice-oriented module											
AAP229	Teaching practice	DB VK	6						6		
AAP269	Research practice	PD VK	8								8
M-5. Research Module											
AAP251	Research work of a master student, including an internship and a master's thesis	NIRM VK	2					2			
AAP241	Research work of a master student, including an internship and a master's thesis	NIRM VK	3						3		
AAP254	Research work of a master student, including an internship and a master's thesis	NIRM VK	5							5	
AAP255	Research work of a master student, including an internship and a master's thesis	NIRM VK	14								14
M-6. Final assessment module											
ECA212	Registration and defense of a master's thesis	IA	8								8
	Total for UNIVERSITY:							30	30	30	30
								60		60	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
			university component (VC)	component of choice (CV)	Total
DB	Cycle of basic disciplines		20	15	35
PD	Cycle of major disciplines		28	25	53
	Total for theoretical training:	*0*	*48*	*40*	*88*
	NIRM				*24*
FE	Final exainination	8			8
	TOTAL:	8	48	40	120

Decision of the Academic Council of Kazntu named after K.Satpayev, Protocol №5 от "24" 11 2022 y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev, Protocol №3 от "17" 11 2022 y.

Decision of the Academic Council of the Institute AaIT. Protocol №2 от 20 "09" 2022 y.

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

AaIT **Institute** Director — **R.K. Uskenbayeva**

ETaST Department Head — **E. Tashtay**

Specialty Council representative from employers — **A.S.Inchin**