Institute of Automation and Information Technology
Department of Electronics, Telecommunication and Space Technologies

EDUCATIONAL PROGRAM
6B07121 - Space technology and engineering

Code and classification of the field of education: 6B07 – Engineering, manufacturing and construction industries
Code and classification of training areas: 6B071 "Engineering and engineering"
Group of educational programs: B067 "Air transport and technology"
NQF level: 6
SQF level: 6
Duration of study: 4 years
Amount of credits: 240

Almaty 2025

Teducational program 6B07121- "Space Engineering and Technology" was approved at a meeting of the Academic Council of KazNRTU named after K.I. Satbayev.

Protocol №10 dated «06» March 2025

Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after K.I. Satbayev.

Protocol № 4 dated December «20» 2024

Educational program 6B07121 -"Space Engineering and Technology" was developed by the academic committee in the direction B067 "Air Transport and Technology".

Name	Academic degree / academic title	Post	Place of work	Signature
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KazNRTU 703-05 Educational program

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KazNRTU 703-05 Educational program

Content

List of abbreviations and designations

NJC KazNRTU named after K.I. Satbayev- Non-profit joint-stock company "Kazakh National Research Technical University named after K.I. Satpayev";

State Educational Standard– State compulsory educational standard of the Republic of Kazakhstan;

MSHE RK– Ministry of Science and Higher Education of the Republic of Kazakhstan;

EP– educational program;

IWS– independent work of the student (student, master's student, doctoral student);

IWST– independent work of the student with the teacher (independent work of the student (master's student, doctoral student) with the teacher);

WC- working curriculum;

SS– space systems;

CED– catalogue of elective disciplines;

ST&E– space technology and equipment;

Remote Sensing– remote sensing of the Earth;

SP– software products;

UC– university component; EC – elective component;

NQF– national qualifications framework;

SQF– sectoral qualifications framework;

LO– learning outcomes;

KC– key competencies;

ER Mapper– A package of software required for processing space image data;

SDG -Sustainable Development Goals.

1. Description of the educational program

The educational program "Space Engineering and Technology" is designed to provide specialized training for bachelors at the NAO "KazNITU named after K.I. Satpayev" and was developed within the framework of the "Engineering and Engineering" direction.

The professional activities of graduates of this educational program are aimed at the aerospace industry, in particular in the field of space systems for remote sensing of the Earth (SS ERS).

The training of specialists in space engineering and technology will be carried out according to the updated educational program (EP) "Space Engineering and Technology", which has two specializations: "Space Systems for Remote Sensing of the Earth" and "Systems for Processing Space Images".

Mission educational program "KTI": training of bachelors - developers of remote sensing systems, users of professional programs for decoding remote sensing space images, who know the information and communication technical and technological base of the industry, technologies for digitalization of spatial data infrastructure using space technology, who have fundamental training in physics, mathematics, physics, electrical and electronic devices. Providing students with knowledge, skills and abilities that allow them to analyze problems in the field of professional activity and find ways to solve them, solve engineering problems of designing remote sensing systems, conduct experimental research work using info communication technologies, mathematical and simulation modeling.

The content of the disciplines of the educational program was developed taking into account the relevant educational programs of leading Russian technical universities and universities around the world, as well as the international classifier of professional activities in the field of aerospace engineering and remote sensing systems.

The types of professional activity are: production and technological; service and operational; organizational and managerial; installation and adjustment; calculation and design; applied industry; experimental research.

The subjects of professional activity are systems that include: the performance of individual technological operations for the creation of space products and the provision of space services based on the use of remote sensing data; technological support and coordination of the implementation of a set of operations for the preparation of a space survey plan, the reception and primary processing of remote sensing data; the development of technologies for the creation of space products and the provision of space services based on the use of remote sensing data.

2. The purpose and objectives of the educational program

The purpose: The goal of the educational program "Space Engineering and Technology" is to train highly qualified specialists in the field of space technology and engineering.

Students will be able to conduct scientific research in the field of space technologies, including the design, modeling and operation of satellite systems,

spacecraft and orbital platforms. They will acquire professional competencies in the field of telemetry, navigation, remote sensing, as well as in the analysis and solution of engineering and technical problems related to space projects. The program provides training of scientific personnel in accordance with international standards, giving graduates the opportunity to work in research institutes, aerospace agencies and companies in the space industry.

Responsibilities:

- -social and humanitarian education based on the laws of social and economic development of society, history, modern information technologies, the state language, foreign and Russian languages.
- Study of a cycle of basic disciplines to form the basis of professional training in the field of natural, general technical and economic sciences.
- Acquisition of theoretical knowledge and development of practical skills in microprocessor complexes designed to control processes in engineering automated control systems and information and communication systems.
- Providing students with knowledge of modern engineering technologies, intelligent microprocessor systems, design of analog and digital circuits, their key aspects and applications.
- Formation of competencies necessary for work in research and innovation centers, in high-tech industries, as well as in the field of scientific and pedagogical activities.
- Developing the ability to assess, analyze and solve production problems, monitor and manage technological processes.
- The disciplines "Introduction to the Specialty", "Fundamentals of Rocket Science", "Fundamentals of Automation", "Physical Fundamentals of Electronics", "Theory of Electrical Circuits", "Theory of Signal Transmission", "Physical Fundamentals of Remote Sensing of the Earth", "Fundamentals of Satellite Navigation Systems", "Microelectronics", "Digital Communication Technology", "Antenna-Feeder Devices", "Satellite Remote Sensing Systems" correspond to all stages of achieving the Sustainable Development Goals SDG 9 – Ensuring and developing integrated technologies for Industry, Innovation and Infrastructure using remote sensing systems.`

The educational program is aimed at preparing graduates working at enterprises, research centers, engineering complexes and institutions related to the development and operation of space technologies. They can work professionally in the field of design and integration of on-board control systems, satellite systems, navigation and telemetry systems, digital signal processing technologies, sensor systems and information and communication tools used in the space industry. In addition, future specialists will be able to contribute to the development of energy-efficient solutions for spacecraft, develop skills in designing, modeling and implementing intelligent control systems for aerospace tasks.

3. Requirements for the assessment of learning outcomes of the educational program

Educational program 6B07121 - "Space Engineering and Technology" ensures that all students achieve the learning outcomes necessary for professional activity. Upon completion of the program, students acquire social and humanitarian knowledge based on the laws of socio-economic development, history, state, Russian and foreign languages, as well as modern information technologies. In addition, they study a cycle of basic disciplines to form professional training in the field of natural, general technical and economic sciences.

Students receive basic theoretical knowledge and practical skills necessary for participation in the development, management and processing of information in the field of space technologies. During the training, they master the methods of performing engineering calculations of the ERS CS, as well as the justification of design solutions using modern computer technologies and specialized software. Competencies in planning and conducting basic technical and laboratory research are formed.

As part of practical training, students become familiar with the key stages of technical organization, planning and management of production processes in the space industry. They acquire skills in working with microprocessor control systems, digital and sensor technologies, satellite communications and remote sensing, as well as methods of information processing using electronic and radio engineering devices.

Graduates of the educational program will be able to work in engineering and technical departments of aerospace enterprises, in research and design organizations, at production facilities and in innovation centers. Their professional activities will be related to the processing and transmission of data using satellite and radio engineering systems, participation in the creation and maintenance of spacecraft, as well as in ensuring the functioning of intelligent control systems in aerospace engineering.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the educational field	6B07 – Engineering, manufacturing and construction industries
2	Code and classification of training areas	6B071 Engineering and engineering
3	Group of educational programs	B067 "Air Transport and Technology"
4	Name of the educational program	6B07121 "Space Engineering and Technology"
5	Brief description of the educational program description	Educational program 6B07121 "Space Engineering and Technology" provides training for specialists in the field of space engineering and technology, Earth Remote Sensing Space Systems and satellite navigation.
6	Purpose	The goal of the program is to train highly qualified specialists in the space industry, possessing deep knowledge, skills and practical abilities that ensure high-quality performance of functional duties in the chosen specialty, mobility in the professional labor market, and knowledge of the latest global

		achievements and development prospects of the aerospace industry.
7	Type of	New
8	Level according to NQF	6
9	Level according to SQF	6
10	Distinctive features of the EP	No
11	List of competencies of the educational program:	Professional competencies; Research competencies; Basic competencies and knowledge; Communicative competencies; General human competencies; Cognitive competencies; Creative competencies; Information and communication competencies. The content of the educational program "Space Engineering and Technology" is implemented in accordance with the credit technology of education and is carried out in the state and Russian languages.
12	Results of the implementation of the educational program:	PO1 - Have basic knowledge of mathematics and physics to solve engineering problems. Know and apply in practice the fundamentals of engineering professional ethics; have basic general engineering knowledge, the ability to solve general engineering problems and tasks. PO2 - Have basic skills in using computer programs and computer systems to solve general engineering problems. PO3 - Use Kazakh, Russian, English as a means of business communication, a source of new knowledge. Have a basic understanding of social, linguistic and economic knowledge, methods and techniques of planning and organizing production. PO4 - Ability to continuously learn, to concentrate; to be self-confident in conditions of uncertainty; to have a high level of spatial and logical thinking; to be focused on achieving results in one's research, to effectively plan and organize one's development. PO5 - Demonstrate a set of skills in managing the work process, the ability to select methods, techniques and evaluation criteria to obtain results. PO6 - Know the principles and methods of processing, research of space technology and their application; principles of digital image processing; features of remote sensing space systems and infocommunication technologies; norms and standards (including international ones) of design documentation applied in the space industry; modern global development trends in the field of remote sensing image processing. PO7 - Implement, test and operate software and hardware systems for decoding remote sensing data; design and develop spacecraft, nano- and pico-satellites, and their elements; apply modern space technologies for processing and transmitting large volumes of information, and analyze it to make optimal decisions. PO8 - have teamwork skills. Have moral, communicative, organizational and managerial skills
13	Form of study	Full-time
14	Duration of study	4 years

15	Volume of loans	240 credit
16	Languages of instruction	Kazakh, Russian, English
17	Academic degrees awarded	Bachelor of Engineering and Technology
18	Developer and authors:	Y. Tashtay

4.2 The relationship between the attainability of the learning outcomes formed under the educational program and academic disciplines

			Number of credits	Formed learning outcomes (codes)							
				RO1	PO2	PO3	PO4	RO5	RO6	RO7	RO8
	Cycle of general education disciplines, Required component										
1	Foreign language	English is a general education subject. After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and subjects. The name of the subject corresponds to the level of English proficiency. When moving from level to level, prerequisites and postrequisites of the subjects are observed.	**10**	V							
2	Kazakh (Russian) language	The course examines socio-political, socio-cultural spheres of communication and functional styles of the modern Kazakh (Russian) language. The course covers the specifics of scientific style in order to develop and activate students' professional and communicative skills and abilities. The course allows students to practically master the basics of scientific style and develops the ability to perform structural and semantic analysis of the text.	**10**	V							
3	Physical culture	The aim of the discipline is the practical use of skills in performing the basic elements of track and field techniques, sports games, gymnastics and a set of standards for general physical training, including professional and applied physical training or one of the sports, methods for conducting independent physical exercise classes.	**8**	V		V					
4	Information and Communication Technologies (MOOC)	The objective of studying the discipline is to acquire theoretical knowledge about information processes, new information technologies, local and global computer networks, methods of information protection; to acquire	**5**	V							

		skills in using text editors and spreadsheet processors; to create databases and various categories of application programs.										
5	History of Kazakhstan	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan from ancient times to the present day. The sections of the discipline include: introduction to the history of Kazakhstan; steppe empire of the Turks; early feudal states on the territory of Kazakhstan; Kazakhstan during the Mongol conquest (13th century); medieval states in the 14th-15th centuries. The main stages of the formation of Kazakh statehood are also considered: the era of the Kazakh Khanate of the 15th-18th centuries; Kazakhstan as part of the Russian Empire; Kazakhstan during the period of civil confrontation and under a totalitarian system; Kazakhstan during the Great Patriotic War; Kazakhstan during the period of independence and at the present stage.	**5**	V							
6	Philosophy	Philosophy forms and develops critical and creative thinking, worldview and culture, provides knowledge about the most general and fundamental problems of existence and provides them with a methodology for solving various theoretical practical issues. Philosophy expands the horizon of vision of the modern world, forms civic consciousness and patriotism, promotes the development of self-esteem, awareness of the value of human existence. It teaches how to think and act correctly, develops skills of practical and cognitive activity, helps to seek and find ways and means of life in harmony with oneself, society, and the world around us.	**5**	V							
7	Module of socio-political knowledge (sociology, political science) (MOOC)	The discipline is designed to improve the quality of both general humanitarian and professional training of students. Knowledge in the field of sociology and political science is	**3**	V							

		the key to effective professional activity of a future specialist, as well as for understanding political processes, for the formation of a political culture, development of a personal position and a clearer understanding of the extent of one's responsibility.									
8	Module of socio-political knowledge (cultural studies and psychology) (MOOC)	The socio-political knowledge module (cultural studies, psychology) is designed to familiarize students with the cultural achievements of mankind, to understand and assimilate the basic forms and universal patterns of formation and development of culture, to develop their desire and skills for independent comprehension of the entire wealth of values of world culture for self-improvement and professional growth. During the course of cultural studies, the student will consider general problems of the theory of culture, leading cultural concepts, universal patterns and mechanisms of formation and development of culture, the main historical stages of formation and development of Kazakhstani culture, its most important achievements. During the course, students acquire theoretical knowledge, practical skills and abilities, forming their professional focus from the standpoint of psychological aspects.	**5**	V							
Cycle of general education disciplines Component of choice											
9	Fundamentals of anti-corruption culture and law	The course introduces students to the improvement of socio-economic relations of Kazakhstani society, psychological features of corrupt behavior. Particular attention is paid to the formation of anti-corruption culture, legal responsibility for corrupt acts in various spheres. The purpose of studying the discipline "Fundamentals of Anti-Corruption Culture and Law" is to increase the public and individual legal awareness and legal culture of students, as well as the	**5**	V		V					

		formation of a system of knowledge and civic position on combating corruption as an anti-social phenomenon. Expected results: to implement the values of moral consciousness and follow moral standards in everyday practice; work to improve the level of moral and legal culture; use spiritual and moral mechanisms to prevent corruption.									
10	Fundamentals of scientific research methods	The main objectives of the academic discipline "Fundamentals of Scientific Research Methods" are to form ideas about the methodological side of cognition, using the concepts and principles of logic and dialectics, as well as to form in students knowledge and understanding of the methodology of scientific research; to teach how to draw up the structure of future scientific work; to teach the correct formulation of the goal, setting tasks; to teach the definition of the object and subject of research; to master the competent selection of methods of scientific research	**5**	V		V					
11	Basics of financial literacy	Formation of students' financial literacy based on the construction of a direct connection between the acquired knowledge and its practical application. Contents: practical use of all kinds of financial management tools, preservation and increase of savings, competent budget planning, acquisition of practical skills in calculating and paying taxes and correct completion of tax reporting, analysis of financial information and orientation in financial products for the selection of an adequate investment strategy.	**5**	V					V		
12	Fundamentals of Economics and Entrepreneurship	The discipline studies the fundamentals of economics and entrepreneurship from the point of view of science and law; features, problematic aspects and development prospects; the theory and practice of entrepreneurship as a system of economic and organizational relations of business structures; the readiness of entrepreneurs for innovative	**5**	V							

		receptivity. The discipline reveals the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of an entrepreneur, theoretical and practical business planning and economic expertise of business ideas, as well as risk analysis of innovative development, implementation of new technologies and technological solutions.									
13	Ecology and life safety	The discipline studies the tasks of ecology as a science, ecological terms, the laws of functioning of natural systems and aspects of environmental safety in the conditions of work. Environmental monitoring and management in the field of its safety. Sources of air pollution, surface, ground water, soil and ways to solve environmental problems; life safety in the technosphere; natural and man-made emergencies	**5**	V		V					
Cycle of basic disciplines University component											
14	Engineering and computer graphics	Study of methods for obtaining certain graphic models of space based on orthogonal projection and the ability to solve problems related to spatial forms and relationships on these models. Mastering the basic principles and methods of geometric modeling and methodology for developing graphic applications. Mastering the knowledge of drawing construction, the ability to read and compose graphic and text design documentation in accordance with the requirements of regulatory documents and state standards. Introducing students to the concept of computer graphics, geometric modeling, graphic objects, and modern interactive graphic systems for solving problems of automating drawing and graphic work using AutoCAD as an example.	**5**	V	V				V		
15	Basics of automation	The course covers general information about actuators, their	**5**		V						

		classification, requirements for them, and their functional characteristics. Pneumatic actuators, hydraulic actuators, electric actuators, controlled control and shut-off valves and their basic diagrams.									
16	Fundamentals of Rocket Science	The course examines issues of methods and means of ensuring interchangeability in rocket engineering, technological characteristics of blanks, technological processes for obtaining permanent connections in parts and units, assembly and installation work in rocket engineering, ensuring long-term storage of rockets, monitoring and testing of rockets, refueling and ampulization of rockets, analysis and synthesis of technical characteristics of rockets based on statistical methods, rocket launch technology.	**5**				V	V			
17	Theoretical foundations of electrical engineering and electronics	The course covers general information about actuators, their classification, requirements for them, and their functional characteristics. Pneumatic actuators, hydraulic actuators, electric actuators, controlled control and shut-off valves and their basic diagrams.	**5**	V					V		
18	Physical principles of electronics	The physical processes that determine the principles of construction and operation of semiconductor devices are considered. Electronic circuits of electronic devices (diodes, thyristors, dinistors, triacs, transistors, etc.) and microcircuits are also considered, the specific area of application of these devices, the main volt-ampere characteristics of electronic devices and the parameters of electronic circuits are indicated.	**5**	V	V				V		
19	Engineering tasks of space remote sensing systems	The course "Engineering Problems of Remote Sensing Space Systems" covers the design and solution of engineering problems related to remote sensing space systems. The main focus is on the development of technologies for processing data obtained from satellites, as well as ensuring the reliability of such systems in outer	**5**	V					V		

		space conditions. Students study methods for creating effective systems for monitoring the Earth and processing large volumes of data using modern engineering solutions. Practical application of knowledge is provided through laboratory work, design of models and modeling of elements of remote sensing systems, which allows students to gain experience in solving real engineering problems.									
20	Introduction to the Space Industry Specialty	General information on the development of space technology and equipment in the world and in Kazakhstan. Stages of creating the material and technical base of the space industry. Specialized design technology bureau. The main regulatory requirements for Earth remote sensing (ERS) data, basic information on ERS space systems. Tasks solved by ERS space systems for various sectors of the economy. Features of the ground segment of space technology. Prospects for the development of space technology.	**5**	V	V				V		
21	Fundamentals of spacecraft orientation and stabilization systems	The course covers passive and combined stabilization systems by rotation, using solar ray pressure, as well as gravitational and gas-reactive systems. It also covers issues of studying the dynamics of elasticity change and thermal deformation of stabilizers. Particular attention is paid to methods and devices for damping oscillations of passive stabilization systems, issues of control and forecasting of spacecraft motion.				V	V				
22	Mathematics I	The course is designed to study the basic concepts of higher mathematics and its applications. The main provisions of the discipline are used in the study of all general education engineering and special disciplines taught by the graduating departments. The sections of the course include elements of linear algebra and analytical geometry, introduction to analysis, differential calculus of functions of one and	**5**	V					V		

		several variables. The issues of methods for solving systems of equations, application of vector calculus to solving problems of geometry, mechanics, physics are considered. Analytical geometry on a plane and in space, differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, derivative in direction and gradient, extremum of a function of several variables									
23	Mathematics II	The course is a continuation of Mathematics I. The sections of the course include integral calculus of functions of one and several variables, the theory of series. Indefinite integrals, their properties and methods of their calculation. Definite integrals and their applications. Improper integrals. Theory of numerical series, theory of functional series, Taylor and Maclaurin series, application of series to approximate calculations.	**5**	V					V		
24	Mathematics III	To teach students integration methods. To teach how to choose the right method for finding the antiderivative. The discipline is a continuation of Mathematics II. The course includes sections: ordinary differential equations and elements of probability theory and mathematical statistics. Differential equations with separable variables, homogeneous, in total differentials, linear non-homogeneous differential equations with constant coefficients, systems of linear differential equations with constant coefficients, finding the probability of events are studied; calculating the numerical characteristics of random variables; using statistical methods for processing experimental data.	**5**	V					V		
25	Microprocessors and microprocessor systems in rocket and space technology	In the course of studying this discipline, students acquire knowledge of the architecture and principles of operation of microprocessors, such elements of microprocessor systems	**5**	V	V				V		

		as operational and read-only memory devices, input-output interfaces, etc., programming of microprocessors and microcontrollers. Study of the capabilities and applications of microprocessor tools; typical architecture of microprocessor systems; organization of subsystems of processing, control, memory and input-output; main tasks and features of designing microprocessor systems; single-crystal microcomputers and controllers; multi-microprocessor systems, main configurations and areas of their use; tools for development and debugging of microprocessor systems.									
26	Microelectronics	The principles of operation, parameters, characteristics and application features of semiconductor devices are considered. Design of various circuits of electric signal amplifiers and generators based on diodes, bipolar and field-effect transistors and development of their operating features. Operational amplifiers. Differential amplifiers. Feedback. Effect of feedback on the main indicators and characteristics of amplifiers. Power amplifiers. Classification of filters and their composition.	**5**				V	V			
27	Satellite communication systems	The course "Satellite Communication Systems" is devoted to studying the principles of functioning of satellite communication systems, their design and operation. Students become familiar with the technologies of data transmission via satellite channels, methods of ensuring the reliability and stability of communication, as well as modern trends in the development of satellite networks. Particular attention is paid to solving communication problems in conditions of limited resources and extreme conditions of space.	**5**						V	V	
28	Physics I	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical	**5**						V		

		research; the influence of physics as a science on the development of technology; the relationship of physics with other sciences and its role in solving scientific and technical problems of the specialty. The course covers the following sections: mechanics, mechanical harmonic waves, the basics of molecular-kinetic theory and thermodynamics, electrostatics, direct current, electromagnetism, geometric optics, wave properties of light, laws of thermal radiation, photoelectric effect.									
29	Physics II	Formation of students' knowledge and skills in using fundamental laws, theories of classical and modern physics, as well as methods of physical research as the basis of a system of professional activity. Contents: harmonic oscillations, damped oscillations. alternating current, wave motion, laws of refraction and reflection of light, quantum optics. laws of thermal radiation, photons, their characteristics, wave function, electrical conductivity of metals, atomic nucleus, its structure and properties, binding energy, radioactivity.	**5**						V		
30	Educational practice	The main objective of the practical training is to provide students with an opportunity to become familiar with the infrastructure of the space industry. Familiarization with the evolutionary development of space activities. The practical training is aimed at acquiring basic skills of practical experience in the field of space technology and prospects for their development. Industrial training is carried out in companies and organizations involved in rocket launches and servicing ground services (Baikonur), development and design of space equipment and technology (TOO KTI, TOO Galam, NTsKIT, JSC FTI, JSC KGS, JSC RCCSS, etc.)	**2**	V							
Cycle of major disciplines University component											

31	Introduction to a specialty in the space industry	General information on the development of space technology and equipment in the world and in Kazakhstan. Stages of creating the material and technical base of the space industry. Specialized design technology bureau. The main regulatory requirements for Earth remote sensing (ERS) data, basic information on ERS space systems. Tasks solved by ERS space systems for various sectors of the economy. Features of the ground segment of space technology. Prospects for the development of space technology.	**5**	V	V				V		
Cycle of basic disciplines Component of choice											
32	Algorithms and data structures	The course covers the main approaches to the analysis and design of algorithms and data structures. The course covers topics such as asymptotic worst-case complexity estimation, efficient sorting algorithms and selection of order statistics, data structures (binary search trees, heaps, hash tables), algorithm design methods (divide and conquer, dynamic programming, greedy strategy), and basic graph algorithms (shortest paths, topological sorting, connected components, minimum spanning trees).	**5**	V	V				V		
33	Lean manufacturing	The objective of the course is to acquire knowledge in the field of total quality management. Lean manufacturing as a model for increasing the efficiency of an enterprise. Organization of the implementation of the lean manufacturing model in production. Kaizen system. "Streamlining" system. "Just-in-time - JIT" system. General productive equipment maintenance system TPM. Key issues in implementing lean manufacturing models. Lean manufacturing project management. Design of work on implementing lean manufacturing systems. Management of	**5**			V				V	V

		the current production process in the area. Personnel management of the area. Lean intra-production logistics.									
34	Inclusive technologies and universal design in engineering systems	This course explores the principles of inclusive technology and universal design in engineering systems. Students will learn how to create accessible environments, adaptive technologies, and ergonomic solutions that provide equal opportunities for all users, including people with disabilities. The course covers the integration of assistive technologies, smart systems, and sustainable design approaches to improve accessibility in a variety of engineering applications.	**5**		V				V		
35	Materials Science and Technology of Space Materials	The discipline "Materials Science and Technology of Space Materials" covers the study of the properties, structure and processing methods of materials used in the space industry. The main focus is on materials that can ensure the reliability and durability of spacecraft in conditions of extreme temperatures, radiation and vacuum. Particular attention is paid to the latest materials, such as superconductors, carbon nanotubes and graphene. These materials open up new opportunities for creating lightweight and ultra-strong structures, miniaturizing equipment and increasing energy efficiency. As a result of studying this discipline, students receive a comprehensive understanding of modern materials and technologies used in the space industry.	**5**				V				
36	Mechanisms and structural elements of spacecraft life support	The course "Mechanisms and Structural Elements of Spacecraft Life Support" covers technical and engineering aspects of creating and maintaining conditions for the functioning of spacecraft and crew life support. Students study the main functional elements of life support systems, such as air regeneration, water supply and purification systems, and temperature control. Particular attention is paid to the development of structures resistant to the effects	**5**				V				V

		of extreme space conditions: radiation, vibration, and temperature fluctuations. Materials and technologies used in the creation of sealed compartments, launch and undocking systems are studied. An important element is the analysis of energy efficiency and reliability of life support systems in long-term flights.									
37	Fundamentals of Artificial Intelligence	Introduces students to the basic concepts, methods and technologies in the field of artificial intelligence: machine learning, computer vision, natural language processing, etc. Contents: general definition of artificial intelligence, intelligent agents, information retrieval and state space exploration, logical agents, architecture of artificial intelligence systems, expert systems, observational learning, statistical learning methods, probabilistic processing of linguistic information, semantic models, natural language processing systems.	**5**	V	V				V		
38	Fundamentals of space industry management	The global space market: status and development prospects. Concept and strategy of the space industry in the Republic of Kazakhstan. Normative legal acts of the Republic of Kazakhstan in the organization of space activities. Business models for commercialization of key segments of the global space market. Models and experience of public-private partnership (PPP) and private financial initiative (PFI) in space activities. Features of innovative management in the space industry. Successful business strategies of leading space companies. Relevance of the development of small-sized spacecraft	**4**			V				V	V
39	Fundamentals of Space Project Management	History, philosophy and methodology of management. Modern theory and technologies of management. Legal aspects of public administration of the space industry. Information and analytical support. Personnel policy and personnel audit Management. Research methods in	**4**			V				V	V

		management. Strategic management. Space technology. Space risks. Risk management methods.									
40	Fundamentals of Sustainable Development and ESG Projects in Kazakhstan	Objective: to provide students with theoretical foundations and practical skills in the field of sustainable development and ESG, as well as to develop an understanding of the role of these aspects in the modern economic and social development of Kazakhstan. Content: introduces the principles of sustainable development and the implementation of ESG practices in Kazakhstan, includes the study of national and international standards, analysis of successful ESG projects and strategies for their implementation at enterprises and organizations.	**5**	V		V					
41	Legal regulation of intellectual property	Objective: to develop a comprehensive understanding of the system of legal regulation of intellectual property, including the basic principles, mechanisms for protecting intellectual property rights and the specifics of their implementation. Content: the course covers the basics of IP legislation, including copyright, patents, trademarks, and industrial designs. Students learn how to protect and manage intellectual property rights, and also examine legal disputes and methods for resolving them.	**5**	V	V	V					
42	Applied Mechanics	Objective: students will master the basics of scientific knowledge in the field of solid mechanics and develop the skills to apply them in practical work in their specialty. Contents: Force vector and its components. Force systems. Methods for specifying the motion of a point. The simplest motions of a rigid body. Plane motion of a rigid body. Complex motion of a point. Dynamics of a material point. Differential equations of motion of a material point. Dynamics of a system of material points. Dalamer's principle for a material point.	**5**	V					V		

43	Technology of production of modern and advanced materials	When studying this discipline, students must learn, as a result of analyzing operating conditions, to select the material and method of manufacturing parts and products using modern technological processes, select optimal methods for studying the properties and structure of materials, determine the mechanical properties of materials, analyze the structure of materials, process the obtained experimental results, analyze technical information in the field of materials science and technology of structural materials.	**5**				V			V	
44	Digitalization of IoT	The "IoT Digitalization" course is devoted to studying modern digitalization methods and technologies for creating and developing Internet of Things (IoT) devices. Students study the architecture of IoT systems, principles of data processing, and the implementation of such technologies in various fields, including space applications. The course helps to master the principles of efficient operation of IoT devices and their integration into remote monitoring and control systems.	**5**	V	V				V		
Cycle of major disciplines Component of choice											
45	Intelligent systems in space technologies	Study of the main tasks of IS, theoretical foundations of artificial intelligence (AI). Representation of problems in natural and formal languages. Fundamentals of mathematical logic of events and probability theory in decision-making. Neural network training strategy. Static learning theory. Decision-making methods, AI application possibilities. Dynamic recovery. Recurrent network architecture. Formal systems. State-space model. Real-time recurrent learning.	**4**	V	V				V		
46	Spacecraft	To study a spacecraft (SC) and its launch vehicle (LV) as actively functioning systems with a high degree of ideality	**4**					V	V	V	

		determined by the ratio of functionality to costs. To understand the design features of SC and LV, to study the basics of designing their main elements, as well as the work and processes occurring in rocket and space technology products. Objective of the discipline: - to study the principles of the design and operation of spacecraft units and systems; - to study the principles of operation of on-board systems and units of a spacecraft. Space flight conditions. Classification of spacecraft. Structural and layout schemes of spacecraft. Composition of spacecraft. Power supply systems. Thermal regime support systems. Motion control systems: information sensors, propulsion systems. On-board complex control systems. Earth probing spacecraft.										
47	Methods of decoding space images	The course covers modern systems for processing space images, methods of image generalization, methods for identifying object contours, clustering methods, methods for identifying image points, algorithms for computer processing of space images, methods of stereoscopic observation, basic functions and potential capabilities of ER Mapper software packages.	**5**				V				V
48	Software packages for processing remote sensing data	The course "Software packages for processing remote sensing data" examines the study of geographic information systems (GIS): ArcGis ArcView with specialized modules for geostatistical analysis, 3D modeling and spatial analysis and GIS MicroStation, software packages for processing remote sensing data: ENVI 4.5 with modules for processing space radar images SARscape Basic and SARscape InSAR; ERDAS Imagine, ScanEX Image Processor, Scan NeRIS.	**5**				V	V			V
49	Aeromechanics of spacecraft	The course provides an understanding of the theoretical foundations of continuum mechanics, elements of gas dynamics, aerodynamics of bodies of various shapes at	**5**				V		V	V	

		subsonic and supersonic speeds, aerodynamics of aircraft, stability and controllability of bodies in environments. It introduces students to the methods of human activity aimed at creating aircraft (LA) and rocket and space technology designed to transport cargo both in the atmosphere and outside it, and systems that ensure the normal functioning and use of aircraft and their complexes.									
50	Ballistics of aircraft	The course provides an understanding of the modern theory of flight of various aircraft, including ballistic missiles and their warheads, launch vehicles and advanced space transport systems, manned spacecraft and vehicles. It introduces students to the principles of constructing multi-step iterative algorithms of terminal control with adaptation to actual flight conditions.	**5**			V				V	
51	On-board control systems	Types of spacecraft and their onboard systems. Functions, structure and composition of the onboard control system. Main technical solutions in the development of onboard control systems. Components of the onboard control system. Design and development of onboard control system software. System for integrated testing of the onboard control system software. Use of simulation modeling stands at different stages of the life cycle of the onboard control system development, testing and maintenance.	**5**			V				V	
52	Simulation model of space technology and equipment	The course focuses on the creation and analysis of models that simulate the operation of space hardware systems and complexes. Students study the methods and tools used to simulate flight dynamics, control system interactions, and analyze operational characteristics. The course covers the use of software for creating virtual prototypes and conducting computer simulations, which allows you to optimize designs and predict the behavior of equipment in real conditions. Particular attention is paid to the reliability	**5**					V	V	V	

		and safety of space systems. Laboratory work includes practical classes on the development and algorithmization of models, where students apply the theoretical knowledge they have acquired. An extensive analysis of technologies and innovations in the space industry helps to understand modern challenges and prospects for the development of this field.									
53	Spatial data infrastructure	goals, objectives and technologies for creating a spatial data infrastructure as an infocommunication system designed for the electronic exchange of spatial data between organizations and companies of different profiles and types of ownership. Objectives of the course: To develop students' systemic knowledge of the main methods of obtaining, storing and exchanging spatial information, to introduce them to the basic concepts, technical and legislative foundations of organizing a spatial data infrastructure, to show the purpose and features of cartographic services; to develop initial skills in creating components of a spatial data infrastructure as a means of systematizing and using heterogeneous spatial information about a territory.	**5**				V	V			V
54	Space systems for remote sensing of the Earth	The course "Space Remote Sensing Systems" studies the principles and technologies of Earth remote sensing using space systems. Students study the methods of collecting, processing and analyzing data obtained using satellites and other spacecraft. The course studies various methods and techniques of image processing to obtain information about the surface and atmosphere of the Earth. Students also get acquainted with the principles of operation of various types of satellite systems and their application in various fields, such as agronomy, ecology, geology, etc. The course helps students develop skills in working with modern equipment and software for processing and analyzing space data.	**5**			V	V			V	V

55	Design of space systems for remote sensing of the Earth	Methods of obtaining remote sensing information. Purpose of remote sensing systems. Spatial resolution of remote sensing systems. Remote sensing systems, their analysis and classification. Requirements for the preliminary design data of remote sensing systems. International standards for the design of remote sensing systems elements. Stages of the working project of remote sensing systems. Remote sensing systems for global observation - class G. Remote sensing systems for regional observation - class R. Remote sensing systems for detailed observation - class L. Features of remote sensing systems design. Remote sensing systems design algorithms	**5**				V	V			V
56	Design of nanosatellites	Classification of spacecraft. Development of nanosatellites. University nanosatellites. Tasks solved by nanosatellites. Need and market for nanosatellites. Main stages and phases of nanosatellite design. Stages of NS development: R&D, production and operation of NS. R&D NS – Technical proposal for NS, Draft design of NS, Technical design of NS and working design documentation of the NS prototype. Design of NS platform components – Onboard control systems, NS orientation and stabilization systems, NS power supply system, Thermal control system, Telemetry control system. NS payload. Nanosatellite life cycle. Cost and trends in reducing the cost of NS launch	**5**					V	V	V	
57	Design of picosatellites	The issues of the theory of designing picosatellites in a system statement, coordination of ballistic design with the characteristics of onboard systems, the problem of layout and evaluation of the design solution according to the developed criterion are considered. Classification of spacecraft. Development of picosatellites. Problems solved by picosatellites. The main stages and phases of designing picosatellites. Technical design of the PS and working	**5**					V	V	V	

		design documentation of the prototype PS. Life cycle of a picosatellite									
58	Robotic systems in space	The discipline studies the historical aspects of the development of space work technology, the purpose and tasks of robotic systems in space programs, space robotics for installation and servicing in space conditions, issues of preparation and conduct of space experiments, ISS robotic systems, tasks and problems of flight operation of robotic systems, prospects for robotic support for the development of space infrastructure.	**5**		V					V	
59	Test systems for space remote sensing systems	The discipline "Systems for testing remote sensing space systems" is devoted to methods and technologies for testing space systems intended for remote sensing of the Earth. Students study the stages of testing satellites and ground equipment, including simulating space conditions, as well as methods for assessing the reliability and efficiency of such systems. Practical application of this knowledge helps improve the quality and durability of space systems.	**5**						V		V
60	Real-time control systems	The purpose of the course is to study brief theoretical information, basic structural solutions with the choice of the element base. The process of programming taking into account the features of the control object and the choice of communication interfaces with sensors and actuators in sections: development of a structural diagram and the choice of the element base, including microprocessors; the choice of interfaces with sensors and actuators; calculation of the speed of information transfer in the communication channel; Developed in accordance with the program of the course "Real-time systems" and is intended for students of electrical engineering and electronics.	**5**		V					V	

61	Spacecraft power supply systems	The course examines various sources of spacecraft power supply systems, such as solar panels, storage batteries, fuel cells, nuclear power plants. Energy consumers on board a spacecraft. Simulation model of power supply. Issues of selection and design of spacecraft power supply systems. Issues of utilization of power sources.	**5**					V		V	
62	Satellite navigation systems	Global satellite navigation systems: elements and principles of operation. Basic information about global navigation systems and their areas of application. Elements and principles of operation of GNSS. Structure of radio signal and factors distorting it. Time scales, coordinate systems, GNSS positioning methods. Coordinate transformation. Orbital motion of GPS and GLONASS satellites. Ephemeris of GLONASS satellites. Decoding and deciphering data from navigation satellites. Solving a navigation problem.						V		V	
63	Satellite positioning systems	General terms and concepts of the SSN. Positioning of the global SSN. Basic concepts of the global navigation satellite navigation system. Satellite signal propagation. Signal reception. Calculating the location. Tasks and features of the GLONASS, Galileo, GPS and BeiDou satellite systems. Sources of SSN errors. Error elimination methods - Multi-constellation, Multi-frequency, Precise point positioning, Data post-processing. Global SSN equipment.	**5**				V			V	
64	Technology of assembly and testing of spacecraft of rocket and space complexes	Types of tests and technical RSC. Composition of RSC. Impact of space factors. Types of RSC tests. Goals and objectives of complex tests. Methodology of spacecraft tests. Tests for impact of mechanical factors. RSC tests for impact of thermal factors. RSC tests for impact of climatic factors. RSC tests for impact of radiation and electromagnetic factors. Calculations and programs of RSC reliability tests. Feasibility study	**4**					V	V	V	

65	Technology for testing on-board control systems	Main characteristics of onboard control microcontrollers. Tasks of ensuring onboard control system fault tolerance. The discipline studies the issues of testing onboard control systems of spacecraft. Main purpose and functions of onboard systems. Loading and debugging tools for onboard programs. Onboard control system power units. Design and composition of electronic and optoelectronic equipment, their testing and verification. Features of onboard control system operation in space conditions. Software and algorithmic complexes of the onboard control system – monitoring and diagnostics. Organization of onboard control system testing and verification. Test equipment. Onboard control system testing methods for vibration, vibration impact, radiation and temperature. Fulfilment of the requirements of ST RK ECSS-M-ST-80C Risk management.						V	V	V	
66	Electronic components for satellite communications	The discipline examines the microelectronic element base of satellite technology, processors for electronic control systems, features of choosing an electronic component base (ECB) for designing space communication devices, the impact of space radiation on ECB, features of choosing the nomenclature of ECB, features of conducting certification tests of ECB, the main stages of development of the element base of radar technology and microwave communications, methods for increasing the radiation resistance of ECB, features of designing a radiation-resistant element base of microwave devices, methods for ensuring the reliability of satellite communication systems	**5**		V				V		

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	**B067 - "Air transport and technologies"**
Educational program	**6B07121 - "Space engineering and technologies"**
The awarded academic degree	**Bachelor of engineering and technology**
Form and duration of study	**full time - 4 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters								Prerequisites
									1 course		2 course		3 course		4 course		
									1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	7 sem	8 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)																	
M-5. Module of anti-corruption culture, ecology and life safety base																	
CHE656	Ecology and life safety	1	GED, CCH	5	150	30/0/15	105	E			5						
HUM136	Fundamentals of anti-corruption culture and law	1	GED, CCH	5	150	30/0/15	105	E			5						
MNG489	Fundamentals of economics and entrepreneurship	1	GED, CCH	5	150	30/0/15	105	E			5						
ELC577	Fundamentals of scientific research methods	1	GED, CCH	5	150	30/0/15	105	E			5						
MNG564	Basics of Financial Literacy	1	GED, CCH	5	150	30/0/15	105	E			5						
M-1. Module of language training																	
LNG108	Foreign language		GED, RC	5	150	0/0/45	105	E	5								
LNG104	Kazakh (russian) language		GED, RC	5	150	0/0/45	105	E	5								
LNG108	Foreign language		GED, RC	5	150	0/0/45	105	E		5							
LNG104	Kazakh (russian) language		GED, RC	5	150	0/0/45	105	E		5							
M-2. Module of physical training																	
KFK101	Physical culture I		GED, RC	2	60	0/0/30	30	E	2								
KFK102	Physical culture II		GED, RC	2	60	0/0/30	30	E		2							
KFK103	Physical culture III		GED, RC	2	60	0/0/30	30	E			2						
KFK104	Physical culture IV		GED, RC	2	60	0/0/30	30	E				2					
M-3. Module of information technology																	
CSE677	Information and communication technology		GED, RC	5	150	30/15/0	105	E				5					
M-4. Module of socio-cultural development																	
HUM137	History of Kazakhstan		GED, RC	5	150	15/0/30	105	GE	5								
HUM120	Module of socio-political knowledge (sociology, political science)		GED, RC	3	90	15/0/15	60	E			3						
HUM132	Philosophy		GED, RC	5	150	15/0/30	105	E			5						
HUM134	Module of socio-political knowledge (cultural studies, psychology)		GED, RC	5	150	30/0/15	105	E				5					
CYCLE OF BASIC DISCIPLINES (BD)																	
M-6. Module of physical and mathematical training																	
MAT101	Mathematics I		BD, UC	5	150	15/0/30	105	E	5								
PHY111	Physics I		BD, UC	5	150	15/15/15	105	E	5								

MAT102	Mathematics II		BD, UC	5	150	15/0/30	105	E		5							MAT101
PHY112	Physics II		BD, UC	5	150	15/15/15	105	E		5							PHY111
MAT103	Mathematics III		BD, UC	5	150	15/0/30	105	E			5						MAT102
M-7. Module of basic training																	
GEN429	Engineering and computer graphics		BD, UC	5	150	15/0/30	105	E	5								
ELC163	Theoretical Foundations of Electrical Engineering		BD, UC	6	180	30/15/0	135	E			6						
ELC606	The physical foundations of electronics		BD, UC	5	150	15/15/15	105	C			5						
PHY107	Applied mechanics	1	BD, CCH	5	150	30/0/15	105	E				5					PHY111, MAT101
ELC698	Spacecraft life support mechanisms and structural elements	1	BD, CCH	5	150	30/0/15	105	E				5					
ELC696	Engineering tasks of remote sensing space systems		BD, UC	4	120	30/15/0	75	C					4				
AUT424	Basics of automation		BD, UC	5	150	30/15/0	105	E								5	
M-8. The fundamentals of space engineering and technology module																	
ELC422	Introduction to the specialty in the space industry		BD, UC	4	120	15/0/15	90	E		4							
ELC612	Fundamentals of rocket science		BD, UC	5	150	30/0/15	105	C				5					
ELC618	Fundamentals of spacecraft orientation and stabilization systems		BD, UC	5	150	30/0/15	105	C						5			
M-9. Module for the production and operation of space technology																	
ELC500	Microelectronics		BD, UC	5	150	30/15/0	105	E				5					
ELC697	Satellite communication systems		BD, UC	4	120	30/15/0	75	C					4				
PHY645	Materials Science and Technology of Space Materials	1	BD, CCH	5	150	30/0/15	105	E					5				
PHY637	Technology of production of modern and promising materials	1	BD, CCH	5	150	15/15/15	105	E					5				
MNG563	Fundamentals of sustainable development and ESG projects in Kazakhstan	2	BD, CCH	5	150	30/0/15	105	E					5				
MNG562	Legal regulation of intellectual property	2	BD, CCH	5	150	30/0/15	105	E					5				
ELC802	Inclusive technologies and universal design in engineering systems	2	BD, CCH	5	150	30/0/15	105	E					5				
ELC617	Microprocessors and microprocessor systems in rocket and space technology		BD, UC	5	150	30/0/15	105	E							5		
MSM444	Methods of non-destructive testing	1	BD, CCH	5	150	15/0/30	105	E								5	
ELC699	Digitalization of IoT	1	BD, CCH	5	150	30/15/0	105	E								5	
M-12. Spatial Data Infrastructure Module																	
CSE678	Algorithms and Data Structures	1	BD, CCH	5	150	15/15/15	105	E					5				
CSE831	Fundamentals of Artificial Intelligence	1	BD, CCH	5	150	15/0/30	105	E					5				
M-14. Creativity Development and Project Management Module																	
ELC621	Fundamentals of space industry management	1	BD, CCH	4	120	30/0/15	75	E							4		
ELC496	Fundamentals of space project management	1	BD, CCH	4	120	30/0/15	75	E							4		
M-16. Practice-oriented module																	
AAP173	Practical training		BD, UC	2				R		2							
CYCLE OF PROFILE DISCIPLINES (PD)																	
M-9. Module for the production and operation of space technology																	
ELC497	Intelligent systems in space technologies		PD, UC	4	120	15/30/0	75	E							4		
ELC616	Robotic complexes in space	1	PD, CCH	5	150	30/0/15	105	E							5		
ELC614	Satellite positioning systems	1	PD, CCH	5	150	30/0/15	105	E							5		
M-10. Module of theoretical and practical bases of remote sensing																	
ELC619	Aeromechanics of spacecraft	1	PD, CCH	5	150	30/0/15	105	E					5				
ELC620	Ballistics of aircraft	1	PD, CCH	5	150	30/0/15	105	E					5				
ELC457	Software complexes for processing Earth remote sensing data		PD, UC	5	150	30/0/15	105	E						5			
ELC800	Simulation model of space engineering and technology	1	PD, CCH	5	150	30/0/15	105	E						5			
KTT116	Space remote sensing systems of the Earth	1	PD, CCH	5	150	30/15/0	105	E						5			

ELC615	Satellite navigation systems	1	PD, CCH	5	150	30/0/15	105	E						5		
ELC607	Design of space systems for remote sensing of the Earth	1	PD, CCH	5	150	30/0/15	105	C						5		
ELC636	Real Time Control Systems	2	PD, CCH	5	150	30/15/0	105	E						5		
ELC555	Electronic components of satellite communications	2	PD, CCH	5	150	30/0/15	105	E						5		
M-11. Space image processing module																	
ELC452	Methods of decrypting satellite images		PD, UC	5	150	30/0/15	105	E					5			
ELC622	Space craft		PD, UC	4	120	30/0/15	75	E					4			
M-12. Spatial Data Infrastructure Module																	
ELC611	On-board control systems	1	PD, CCH	5	150	30/0/15	105	E					5			
ELC625	Spatial data infrastructure	1	PD, CCH	5	150	30/0/15	105	E					5			
M-13. Power supply and thermal control module for spacecraft																	
ELC466	SC power supply systems	1	PD, CCH	5	150	30/0/15	105	E						5		
ELC801	Remote sensing space system test systems	1	PD, CCH	5	150	30/0/15	105	E						5		
M-15. Space technology design module																	
ELC609	Design of nanosatellites	1	PD, CCH	5	150	30/0/15	105	E						5		
ELC608	Picosatellite design	1	PD, CCH	5	150	30/0/15	105	E						5		
M-16. Practice-oriented module																	
AAP102	Production practice I		PD, UC	2				R				2					
AAP183	Production practice II		PD, UC	3				R					3				
M-17. Final assessment module																	
ECA103	Final examination		FA	8											8		
Module R&D																	
ELC623	Technology of assembly and testing of spacecraft of rocket and space complexes	1	PD, CCH	4	120	30/0/15	75	E							4		
ELC624	Technology for testing on-board control systems	1	PD, CCH	4	120	30/0/15	75	E							4		
Additional type of training (ATT)																	
AAP500	Military training																
Total based on UNIVERSITY:									32	28	31	29	28	32	28	32	
									60		**60**		**60**		**60**		

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	51	0	5	56
BD	Cycle of basic disciplines	0	80	29	109
PD	Cycle of profile disciplines	0	23	44	67
Total for theoretical training:		**51**	**103**	**78**	**232**
FA	Final attestation				8
TOTAL:					**240**

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 22.11.2024

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

Signed:	
Governing Board member - Vice-Rector for Academic Affairs	Uskenbayeva R. K.
Approved:	
Vice Provost on academic development	Kalpeyeva Z. Б.
Head of Department - Department of Educational Program Management and Academic-Methodological Work	Zhumagaliyeva A. S.
acting Director of Institute - Institute of Automation and Information Technologies	Chinibayev Y. Г.
Department Chair - Electronics, telecommunications and space technologies	Tashtay Y. .
Representative of the Academic Committee from Employers ____Acknowledged____	Dzhanikeyev M. S.