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

# EDUCATIONAL PROGRAM

## 6B07121– Space engineering and technology

| | |
|---|---|
| Code and classification of the field of education: | 6B07 – Engineering, manufacturing and construction industries |
| Code and classification of training directions: | 6B071 – Engineering and Engineering business |
| Group of educational programs: | B067 - «Air transport and technology» |
| Level based on NQF: | Level 6 – higher education and practical experience |
| Level based on IQF: | Level 6 – a wide range of special (theoretical and practical) knowledge (including innovative). Independent search, analysis and evaluation of professional information |
| Duration of the teducation: | 4 years |
| Amount of credits: | 240 |

**Almaty 2023**

Образовательная программа 6B07121 «Космическая техника и технологии» утверждена на заседании Учёного совета КазНИТУ им. К.И.Сатпаева.
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Образовательная программа 6B07121 «Космическая техника и технологии» разработан академическим комитетом по направлению B067 «Воздушный транспорт и технологии».

| Ф.И.О. | Учёная степень/ учёное звание | Должность | Место работы | Подпись |
|---|---|---|---|---|
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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
**SP** – software products
**UC** – a university component;
**CC –** a component of choice;
**NQF** – National Qualifications framework;
**IQF** – industry qualifications framework;
**LO** – learning outcomes;
**KC** – key competencies.
**ER Mapper** – a package of software required for processing satellite image data

## 1 Description of the educational program

The educational program "Space Engineering and Technologies" is intended for the implementation of specialized bachelor's degree training at the NAO KazNITU named after K.I. Satpayev and was developed within the framework of the direction "Engineering and Engineering".

This document meets the requirements of the following legislative acts of the Republic of Kazakhstan and regulatory documents of the Ministry of Education and Science of the Republic of Kazakhstan:

- The Law of the Republic of Kazakhstan "On Education" with amendments and additions within the framework of legislative changes to increase the independence and autonomy of universities dated 07/04/18 No. 171-VI;
- The Law of the Republic of Kazakhstan "On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on the expansion of academic and managerial independence of higher educational institutions" dated 07/04/18 No. 171-VI;
- Order of the Minister of Education and Science of the Republic of Kazakhstan dated 10/30/18 No. 595 "On approval of Standard Rules for the activities of educational organizations of appropriate types";
- The State mandatory standard of higher education (Appendix 7 to the order of the Minister of Education and Science of the Republic of Kazakhstan dated 31.10.18 No604;
- Resolution of the Government of the Republic of Kazakhstan dated 01/19/12 No. 111 "On approval of Standard Rules for admission to educational institutions implementing educational programs of higher education" with amendments and additions dated 07/14/16 No. 405;
- Resolution of the Government of the Republic of Kazakhstan dated 12/27/2019 No. 988 "On approval of the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020-2025";
- Resolution of the Government of the Republic of Kazakhstan dated 12/31/2019 No. 1050 "On approval of the State Program of Industrial and Innovative Development of the Republic of Kazakhstan for 2020 - 2025";
- "National Qualifications Framework", approved by the protocol dated 06/16/2016 by the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations.

The professional activity of graduates of this educational program is directed to the aerospace industry, in particular in the field of space systems for remote sensing of the Earth (remote sensing).

The training of specialists in space technology and technology will be carried out according to the updated educational program (EP) "Space Technology and Technology", which has two specializations: "Space systems for remote sensing of the Earth" and "Satellite image processing systems".

The mission of the educational program is to train bachelor's degree developers of remote sensing systems, users of professional programs for decrypting remote sensing satellite images, who know the information and communication technical and

technological base of the industry, technologies for digitalizing 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 using information and communication technologies, mathematical and simulation modeling.

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

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

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

Types of economic activity: developer, operator for maintenance of remote sensing control systems, quality manager, manager for the organization of decryption of satellite images, manager for telecommunication processes, manager for digitization of satellite imagery objects, electronics engineer for remote sensing control, locksmith for maintenance and repair of equipment, locksmith for repair of devices, operator of the control panel, etc.

## 2. The purpose and objectives of the educational program

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

The task of the new educational program is:

- study of the cycle of general education disciplines to ensure;
- social and humanitarian education based on the laws of socio-economic development of society, history, modern information technologies, the state language, foreign and Russian languages;
- study of the cycle of basic disciplines to ensure knowledge of natural science, general technical and economic disciplines as the foundation of professional education;
- the cycle of core disciplines is focused on the study of key theoretical and practical aspects of elements and systems of space technology, their interrelation, space technology, in particular methods of remote sensing of the Earth;

- the study of disciplines that form the knowledge, skills and abilities of planning and organizing research, designing work in the field of space technology and technology;

- familiarization with technologies, equipment, test benches, space launch platforms, telecommunication and spacecraft control centers;

- acquisition of skills and abilities in laboratory research, technological calculations, equipment selection and design using modern computer technologies and programs.

- training of a new competitive generation of technicians in the field of satellite image processing for the labor market, proactive, able to work in a team, possessing high personal and professional competencies;

- integration of educational and scientific activities;

- establishing partnerships with leading universities of the near and far abroad in order to improve the quality of education, to support technical and cultural ties;

- expansion of relations with customers of educational services, employers in order to determine the requirements for the quality of training, conducting courses, seminars, master classes, internships.

According to the educational program, such disciplines are studied as: "Introduction to the specialty", "Fundamentals of rocket engineering", "Fundamentals of automation", "Physical foundations of electronics", "Theory of electrical circuits", "Theory of signal transmission", "Physical foundations of remote sensing of the Earth", "Fundamentals of satellite navigation systems", "Microelectronics", "Digital communication technology", "Antenna-feeder devices", "Remote sensing satellite systems", "Methods of interpretation of remote sensing data", "Methods of decryption of aerospace images", "Spatial data infrastructure", "Methods of combining satellite images and their integration into GIS," etc.

Students will practice in such companies as JSC "Kazakhstan Garysh Sapary", JSC "National Space Research Center", DTOO "Space Engineering and Technologies", LLP JV "Galam", LLP "Center for Remote Sensing and GIS "Terra", ASKB "Alatau", LLP "Kazakhstan ASELSAN engineering", The International Space School in Baikonur, etc., as well as at the basic service centers of large international remote sensing companies in the Republic of Kazakhstan.

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

### B – basic knowledge, skills and abilities

B1 – to know the modern history of the Republic of Kazakhstan, stages and prospects of development of the state;

B2 – the ability to use modern technologies to access and share information sources. Possess computer skills as a means of managing, storing and processing information and performing calculations using general and applied software products.

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

B4 – to 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 – the ability to use knowledge and methods of general engineering disciplines (fundamentals of automation and mechanics) in practice.

B6 – awareness in the field of financial analysis and evaluation of projects, project management and business, in the basics of macro and microeconomics, knowledge and understanding of risks in market conditions.

B7 – familiarization with the technological processes of developing new equipment and technology in the space industry and the history of the formation of the industry in introductory practice.

B8 – to know and master the main business processes in the infrastructure units of the space industry of the republic.

**P – professional competencies, including those in accordance with the requirements of industry professional standards**

P1 – a wide range of theoretical and practical knowledge in the professional field;

P2 – proficiency in professional terminology and the ability to work with educational and scientific materials in the specialty in the original in the state, Russian and foreign languages. The ability to logically correctly, argumentatively, and clearly build oral and written speech in three languages

P3 – knowledge of requirements The rules of occupational safety and health at work and the ability to use them in practice.

P4 – knowledge of the culture of professional safety; the ability to identify hazards and assess risks in their field; knowledge of the basic methods of protecting production personnel and the public from the possible consequences of accidents, catastrophes, natural disasters and improving working conditions in the field of professional activity.

P5 – willingness to apply professional knowledge to prevent and minimize negative environmental consequences in the production of the space industry.

P6 – the ability to use the normative legal acts of the space industry and documents in their activities.

P7 – the ability to apply modern information and communication technologies in the field of professional activity

P8 – be able to realize the social significance of your future profession. Have knowledge of the formation and development of the space industry in Kazakhstan and current priority trends in the development of the industry

P9 – to be able to combine problem theory and practice to solve engineering problems, to carry out balanced thermal engineering, hydraulic, aerodynamic calculations of processes and devices, based on practical data.

P10 – be able to apply in practice the principles of rational use of electronic and electrical components of the CS .

P11 – be able to select measuring instruments in accordance with the required accuracy and operating conditions of space technology.

P12 – be able to identify objects for improvement in space technology and technology.

P14 – the ability to identify trends and trends in the development of applied space technology tasks for the development of economic sectors.

P15 – be able to choose research methods, plan and conduct the necessary experiments, interpret the results and draw conclusions.

P16 – Calculate and analyze technological processes for the purpose of further automation and robotization of complexes.

P17 – have the ability to analyze and synthesize data from satellite navigation systems.

P18 – be able to use the basic concepts of the theory of signal transmission, the physical foundations of remote sensing of the Earth, as well as laser scanning of the Earth.

P19 – be able to design elements of GIS systems and the use of GIS in various sectors of the economy .

P20 – independently perform: calculations of equipment; drawings of parts and structural elements; calculations for strength and rigidity; calculations of remote sensing control system parts and mechanisms; select electrical equipment and calculate its operating modes; propose an automation system for the main equipment.

P21 – be able to justify the choice of antenna-feeder devices, the choice of radio wave frequencies in free space.

P22 – to decrypt satellite images, to know and demonstrate image generalization methods, algorithms for computer processing of satellite images and to use the potential capabilities of ER Mapper software systems.

P23 – be able to work in operational ground-transmitting complexes, know the methods of organizing technological processes for the operation of the ground segment of rocket and space technology.

**U – universal, social and ethical competencies**

U1 – to take a careful attitude to the environment of rocket and space technology in work and daily life.

U2 – to take into account ethical and legal norms in interpersonal communication, knowledge and understanding of one's rights and obligations as a citizen of the republic.

U3 – the ability to critically generalize, analyze and perceive socio-political information using the basic laws of society's development in solving social and professional tasks, the ability to analyze socially significant problems and processes in society. Possess culture and logic of thinking, an understanding of the general laws of the development of society and the ability to analyze them.

U4 – awareness of the need and acquisition of the ability to independently study and improve their skills throughout their work.

U5 – understanding and practical use of healthy lifestyle standards, including prevention issues to improve performance

U6 – the ability to build interpersonal relationships and work in a group (in a team).

*Special requirements for graduation from the university in this field:*

– the student must have a general understanding of the topic of the thesis / research plans, and contact potential scientific supervisors one year before the expected completion of studies;

– in order to get acquainted with potential scientific supervisors and accelerate students' choice of topics for their thesis (project), a review meeting one year before the expected completion of studies with organizations and enterprises of the space industry within the framework of industrial practice;

– in order to collect the necessary data and study current tasks, methods and procedures on the topic of the thesis, the student undergoes an internship on the chosen topic;

– upon completion of the internship, the student contacts the supervisor in writing or orally and reports on the results of the work, but no more than a week after the beginning of the 4th year of study;

– within 4 weeks after the start of study, the student and the supervisor must discuss and decide on the type (researchproject or independent study) and the topic of the thesis. This is an extremely important discussion and decision, since it is impossible to further change the topic and type of work;

– the topic of the thesis (project) and the supervisor are assigned to the student or a group of students no more than six weeks after the start of the final year of study and approved by the order of the rector of the higher educational institution.

# 4. Passport of the educational program
## 4.1. General information

| № | Field name | Note |
|---|---|---|
| 1 | The code and classification of the field of education | 6B07 Engineering, manufacturing and construction industries |
| 2 | The code and classification of education areas | 6B071 Engineering and Engineering business |
| 3 | Group of educational programs | B067 «Air transport and technology» |
| 4 | Name of the educational program | 6B07121- «Space engineering and technology» |
| 5 | A brief description of the educational program | The educational program 6B07121 "Space engineering and technology" involves the training of specialists in the field of space technology and technology, space systems for remote Sensing of the Earth and satellite navigation. |
| 6 | The purpose of the EP | The purpose of the OP is to train highly qualified specialists in the field of the space industry with in–depth knowledge, skills and practical skills that ensure high-quality performance of functional duties in their chosen specialty, mobility in the professional labor market, who know the latest world achievements and prospects for the development of the aerospace industry. |
| 7 | Type of EP | New |
| 8 | The level based on NQF | Level 6 – higher education and practical experience |
| 9 | The level based on IQF | Level 6 – 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 | The list of competencies of the EP | Professional competencies;<br>Research competencies;<br>Basic competencies and knowledge;<br>Communicative competencies;<br>Universal competencies;<br>Cognitive competencies;<br>Creative competencies; Information and communication competencies. |
| 12 | Learning outcomes of the EP | **LO1** - Have basic knowledge of mathematics and physics to solve engineering problems. To know and put into practice the basics of engineering professional ethics; to have basic general engineering knowledge, the ability to solve general engineering tasks and problems. |

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| | | **LO2** - Have basic skills in using computer programs and computer systems to solve general engineering problems.<br>**LO3** - Use Kazakh, Russian, English as a means of business communication, a source of new knowledge. Master the basics of social, linguistic and economic knowledge, methods and methods of planning and organizing production.<br>**LO4** - The ability to constantly learn, to concentrate attention; 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 their research, effectively plan and streamline their development.<br>**LO5** - Demonstrate a set of skills for managing the work process, the ability to choose methods, techniques and evaluation criteria to obtain results.<br>**LO6** - To know the principles and methods of processing, research of satellite images and their applications; principles of digital image processing; features of network and infocommunication technologies; norms and standards (including international ones) of project documentation used in the space industry; current global trends in the field of remote sensing image processing.<br>**LO7** - Implement, test and operate software and technical systems for remote sensing data decryption; design electrical devices and their elements in various areas of the digital economy; apply modern technologies for processing and transmitting large amounts of information, analyze it to make optimal decisions.<br>**LO8** - have the skills to work in a team of decoders and users of remote sensing data. Possess moral, communicative, organizational and managerial skills |
| 13 | The form of education | Full-time |
| 14 | The duration of the education | 2 years |
| 15 | Language of education | Kazakh/russian |
| 16 | Amount of credits | 120 credits |
| 17 | Academic degree awarded | Bachelor of Engineering and Technology |
| 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 |
| **The cycle of general education disciplines<br>Required component** | | | | | | | | | | | |
| 1 | Foreign language | English is a discipline of the general education cycle. After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and disciplines. The name of the discipline corresponds to the level of English proficiency. During the transition from level to level, the prerequisites and post-prerequisites of discipline are observed. | 10 | V | | | | | | | |
| 2 | Kazakh (Russian) language | The socio-political, socio-cultural spheres of communication and functional styles of the modern Kazakh (Russian) language are considered. The course highlights the specifics of the scientific style in order to develop and activate students' professional and communication skills. 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 purpose of the discipline is the practical use of skills in performing the basic elements of athletics techniques, sports games, gymnastics and a set of standards for general physical training, including professionally applied physical training or one of the sports, methods of conducting independent physical exercises. | 8 | V | | | | | | | |
| 4 | Information and Communication Technology (MOOC) | The task of studying the discipline is to acquire theoretical knowledge about information processes, about new information technologies, local and global computer networks, information security methods; gain skills in using text editors and tabular processors; create databases and various categories of application programs. | 5 | | | | V | | | | |

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| 5 | The 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; the steppe empire of the Turks; early feudal 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; step empire of the Turks; early feudal states on the territory of Kazakhstan; Kazakhstan during the Mongol conquest (XIII century); medieval states in the XIV-XV centuries. The main stages of the formation of the Kazakh statehood are also considered: the era of the Kazakh Khanate of the XV-XVIII centuries. Kazakhstan as part of the Russian Empire; Kazakhstan during the period of civil confrontation and under the conditions of the 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 gives them a methodology for solving various theoretical and practical issues. Philosophy expands the horizon of vision of the modern world, forms citizenship and patriotism, promotes self-esteem, awareness of the value of human existence. It teaches you to think and act correctly, develops practical and cognitive skills, helps you search and find ways and means of living in harmony with yourself, society, and the world around you. | 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 the key to effective professional activity of a future specialist, as well as for understanding political processes, for the formation of political culture, developing a personal position and a clearer understanding of the measure of their responsibility. | 3 | | | | V | | | | |
| 8 | Socio-political Knowledge Module | The module of socio-political knowledge (cultural studies, psychology) is designed to familiarize students with the | 5 | | | | V | | | | |

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| | (Cultural Studies and Psychology) (MOOC) | cultural achievements of mankind, to understand and assimilate the basic forms and universal patterns of formation and development of culture, to develop their aspirations and skills to independently comprehend the wealth of values of world culture for self-improvement and professional growth. During the course of cultural studies, the student will consider the general problems of the theory of culture, the leading cultural concepts, universal patterns and mechanisms of formation and development of culture, the main historical stages of the formation and development of Kazakh culture, its most important achievements. During the course, students acquire theoretical knowledge, practical skills and abilities, forming their professional orientation from the perspective of psychological aspects. | | | | | | | | | |
| **The cycle of general education disciplines<br>Component of choice** | | | | | | | | | | | |
| 9 | Fundamentals of anti-corruption culture and law | The course introduces students to the improvement of socio-economic relations of the Kazakh society, the psychological characteristics of corrupt behavior. Special attention is paid to the formation of an anti-corruption culture, legal responsibility for acts of corruption in various fields. The purpose of studying the discipline "Fundamentals of anti-corruption culture and law" is to increase public and individual legal awareness and legal culture of students, as well as the formation of a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to realize the values of moral consciousness and follow moral norms in daily practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption. | 5 | | | V | | | | | |
| 10 | Fundamentals of scientific research methods | The main objectives of the discipline "Fundamentals of scientific research methods" is to form ideas about the methodological side of cognition, using the concepts and principles of logic and dialectics, as well as to form students' knowledge and understanding of the methodology of scientific research; to teach the structure of future scientific work; to teach the correct formulation of goals, objectives; to teach the | 5 | | | V | | | | | |

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| | | definition of the object and subject of research; to master the competent selection of scientific research methods | | | | | | | | | |
| 11 | Fundamentals of Economics and entrepreneurship | The discipline studies the basics of economics and entrepreneurship from the point of view of science and law; features, problematic aspects and development prospects; theory and practice of entrepreneurship as a system of economic and organizational relations of business structures; readiness of entrepreneurs for innovative 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, the introduction of new technologies and technological solutions. | 5 | | | V | | | | | |
| 12 | Ecology and life safety | The discipline studies the tasks of ecology as a science, environmental terms, the laws of the functioning of natural systems and aspects of environmental safety in working conditions. Environmental monitoring and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems; safety of life in the technosphere; natural and man-made emergencies | 5 | | | V | | | | | |
| **The cycle of basic disciplines<br>The university component** | | | | | | | | | | | |
| 13 | Engineering and computer graphics | The study of ways to obtain certain graphical models of space based on orthogonal projection and the ability to solve problems related to spatial forms and relationships using these models. Mastering the basic principles and methods of geometric modeling and methodology for the development of graphical applications. Mastering the knowledge of drawing construction, the ability to read and compose graphic and textual 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 automation of drawing and graphic works using the example of AutoCAD. | 5 | V | | V | | | | | |

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| 14 | Basics of automation | The course covers general information about actuators, classification, requirements for them, and their functional characteristics. Pneumatic actuators, hydraulic actuators, electric actuators, controlled control and pipe fittings and their schematic diagrams. | 5 | | V | | | | V | | |
| 15 | Theoretical foundations of electrical engineering electronics | The course covers general information about actuators, classification, requirements for them, and their functional characteristics. Pneumatic actuators, hydraulic actuators, electric actuators, controlled control and pipe fittings and their schematic diagrams. | 6 | | | | | V | | | |
| 16 | The physical foundations of electronics | The physical processes determining 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 scope of application of these devices, the main voltage characteristics of electronic devices and the parameters of electronic circuits are indicated. | 5 | | | | | V | | | |
| 17 | Programming in a high-level language | Students get acquainted with the basic structures of algorithms: linear, branched, cyclic, with the integrated application development environment Visual Studio; study the forms of representation of algorithms using verbal descriptions, flowcharts, pseudocode, creating console applications, studying the basic data types, counters, cycles, arrays, as well as user interface development; study the principles of building flow diagrams, data DFD (Data Flow Diagram). | 5 | | V | | | | V | | |
| 18 | Engineering tasks in MatLab | The discipline is aimed at studying typical mathematical schemes of system modeling, familiarization with the basic approaches of simulation modeling of systems, the study of modern methods of simulation of physical control processes in devices, automation equipment and technological processes in the MATLAB environment. | 5 | | V | | | V | | | |
| 19 | Fundamentals of satellite navigation systems | The course discusses the issues of joint use of GLONASS, GPS and the future Galileo satellite navigation systems. The structure of satellite navigation systems, issues of modeling the orbital situation, potential sources of errors in navigation measurements, consumer navigation methods using satellite systems and the differential mode of operation of the SNA. | 5 | | | | | | V | V | |

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| | | Various additions are considered: local differential correction and wide-band differential subsystems WAAS/MSAS/EGNOS. The characteristics of navigation systems are presented. | | | | | | | | | |
| 20 | Introduction to the specialty of the space industry | General information about the formation of space technology and technology in the world and in Kazakhstan. Stages of creation of the material and technical base of the space industry. A special design and technological bureau. The main regulatory requirements for remote sensing data of the Earth (remote sensing), basic information of remote sensing space systems. Tasks solved by remote sensing systems for various sectors of the economy. Features of the ground segment of space technology. Prospects for the development of space technologies. | 4 | | | V | | V | | | |
| 21 | Fundamentals of spacecraft orientation and stabilization systems | The course covers passive and combined stabilization systems by rotation, using the pressure of sunlight, as well as gravitational and gas-reactive systems. The issues of studying the dynamics of changes in elasticity and thermal deformation of stabilizers are also considered. Special attention is paid to methods and devices for damping vibrations of passive stabilization systems, issues of control and forecasting of spacecraft movement. | 5 | | | | | | V | | V |
| 22 | Theory of signal transmission | General information about the formation and transmission and reception of signals in transmission systems (classification of signals, description of signals, processing and transmission of analog and digital signals). Transmission and processing of signals; patterns determining the properties of signals and transmission of their functioning. Elements of transmission systems and types of signals; communication channels and their characteristics; purpose and main types of modulations and demodulations; methods and devices of noise-resistant coding. | 5 | | | | | | | V | |
| 23 | 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 engineering and special disciplines taught by graduate departments. The course sections include elements of linear algebra and analytical | 5 | V | | | | | | | |

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| | | geometry, an introduction to analysis, and differential calculus of functions of one and several variables. The issues of methods for solving systems of equations, the application of vector calculus to solving problems of geometry, mechanics, and physics are considered. Analytical geometry on the plane and in space, differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, Directional derivative and gradient, extremum of a function of several variables | | | | | | | | | |
| 24 | Mathematics II | The discipline is a continuation of Mathematics I. The sections of the course include integral calculus of a function of one variable and several variables, series theory. 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 | | | | | | | |
| 25 | Remote sensing data processing software packages | The course "Remote sensing data processing software complexes" examines the study of geoinformation systems (GIS): ArcGIS ArcView with specialized modules for geostatistical analysis, 3D modeling and spatial analysis and GIS MicroStation, software complexes for processing Earth 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 | | | |
| 26 | Methods of decryption of satellite images | The course covers modern satellite image processing systems, image generalization methods, object contour selection methods, clustering methods, image point selection methods, algorithms for computer processing of satellite images, stereoscopic observation methods, basic functions and potential capabilities of ER Mapper software systems | 5 | | | V | | | | V | |
| 27 | Methods of interpretation of remote sensing data | The course examines modern remote sensing systems and the main characteristics of the data obtained with their help. The main methods of preliminary and thematic processing of satellite images are presented. The description of software packages used for processing Earth remote sensing data, such as ERDAS Imagine, ERDAS ER Mapper, ENVI and ScanEx | 5 | | | | | | | V | V |

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| | | software products is given | | | | | | | | | |
| 28 | Physics | The course examines the basic physical phenomena and laws of classical and modern physics; methods of physical 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, fundamentals of molecular kinetic theory and thermodynamics, electrostatics, direct current, electromagnetism, geometric optics, wave properties of light, laws of thermal radiation, photoelectric effect. | 5 | V | | | | | | | |
| 29 | Fundamentals of GIS technologies | The course discusses the issues of GIS technology components, their structure, spatial objects, ArgGis data types, problems solved by GIS technologies, areas and levels of GIS use, introduction to remote sensing of the Earth, vector and raster data model, types of spatial data, spatial data analysis, cartographic and geoinformation GIS data structures, GIS design issues, the use of GIS in various sectors of the economy. | 5 | | | | | V | | | |
| 30 | Intelligent systems | The purpose of mastering the discipline "Intelligent Systems" is to form students' understanding of the principles of developing and using intelligent and expert systems used to solve economic and technical problems. | 5 | | | | | | V | | V |
| 31 | Intelligent networks | The course examines the problems that lead to problems in the network and ways to solve them, the rationale for installing Smart Grid components, ways to update the existing network infrastructure, management features and methods for implementing sensor technologies in smart networks, the advantages and benefits of implementing smart networks – distributed generation, power electronics, virtual power plants, data concentrators via satellite navigation network, optical fiber, radio communications and the widespread adoption of digital devices. New methods of management theory. | 5 | | | | | | V | | V |
| 32 | Educational practice | The main purpose of the training practice is to provide students with the opportunity to get acquainted with the infrastructure of the space industry. Introduction to the evolutionary development of space activities. The educational practice is aimed at acquiring initial skills and practical experience in the | 2 | | | | | V | | | |

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| | | field of space technology and prospects for their development. Production practice is carried out in companies and organizations engaged in launching rockets and servicing ground services (Baikonur), the development and design of space technology and technology (KTiT LLP, Galam LLP, NCKIT, FTI JSC, KGS JSC, RCCC JSC, etc.) | | | | | | | | | |
| **The cycle of core disciplines<br>The university component** | | | | | | | | | | | |
| 33 | Theory of electrical communication | The discipline is one of the fundamental ones and determines the professional training of specialists by its content. The TPP course adopted a unified methodological approach to the analysis and synthesis of modern communication systems and devices based on probabilistic models of information, messages, signals, interference and channels in telecommunication systems. The knowledge and skills acquired during the study of this course are necessary for further professional activity. | 5 | | | | V | | | | |
| 34 | Theory of electrical circuits | Basic laws, elements and parameters of electrical circuits. Transformation of circuits. Methods for calculating complex DC circuits. Nonlinear DC electrical circuits. Introduction to the theory of alternating current electrical circuits. Sinusoidal currents and voltages. Resonant phenomena in alternating current circuits. Chains with mutual induction. Three-phase current. Nonlinear alternating current circuits. Four-pole | 5 | | | | V | | | | |
| 35 | The physical foundations of remote sensing of the Earth | The physical basis of electromagnetic wave propagation. Waves at the boundary of different media. Resonant frequencies of molecules. Theoretical foundations of medium polarization and radiation scattering for remote sensing, as well as methods for detecting light scattering by molecules and macroscopic particles. The equation of radiation propagation. Kirchhoff's law and radiometry. Methods of radiometric observation of atmospheric parameters and reverse conversion of remote sensing data. | 5 | | | | | V | | V | |
| 36 | Fundamentals of rocket and space technology | The course "Fundamentals of Rocket and Space Technology (hereinafter RCT)" contains the following sections: physical conditions of space flight, fundamentals of flight mechanics of rocket and space technology, methods for determining the | 5 | | | | | | V | | |

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| | | aerogasodynamic characteristics of RCT, classification of rocket and space systems, features of the creation of space complexes, disposable and reusable launch vehicles, the functioning of liquid rocket engines for launch vehicles, varieties of complex tests of RCT devices and assemblies. | | | | | | | | | |
| 37 | Fiber-optic transmission systems | The types and main types of optical linear communication structures, their design, operational characteristics, electrical parameters; bandwidth requirements; model of a fiber-optic transmission system; optical connectors, splices and passive optical devices; wavelength division multiplexing; technological processes during operation, repair and construction of optical linear structures; rules safety precautions when working on lines. | 5 | | | | | V | | | |
| 38 | Microelectronics | The principles of operation, parameters, characteristics and application features of semiconductor devices are considered. Designing various circuits of electrical signal amplifiers and generators based on diodes, bipolar and field-effect transistors and working out the features of their functioning. Operational amplifiers. Differential amplifiers. Feedback. The effect of feedback on the main indicators and characteristics of amplifiers. Power amplifiers. Classification of filters and their composition. | 5 | | | V | | | | | |
| 39 | Fundamentals of digital communication processing in radar systems | The course "Fundamentals of digital signal processing in radar systems" is designed to consider promising areas of digital processing in relation to the tasks of radar systems and the discipline contains the following sections: methods of signal approximation based on the theory of Wittner-Kotelnikov-Shannon, the use of bispectral analysis in digital signal processing, multi-position radar systems with synthesized antenna aperture, modern methods of signal processing in surveillance radars and RSA, algorithms for blind signal processing and numerical methods for analyzing signals in radar. | 5 | | | | V | | | | |
| 40 | Fundamentals of digital communication processing in BKU | The course "Fundamentals of digital communication processing BKU" is designed to address the development and design of multilevel signal processing in BKU: methods and specifics of information exchange organization, requirements, | 5 | | | | V | | | | |

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| | | modeling of on-board information exchange systems, signal spectra, two-dimensional Fourier transform, methods for describing discrete signals and frequency domain systems, spectral analysis of discrete signals, linear and nonlinear signal filtering. | | | | | | | | | |
| 41 | Introduction to Robotics | The discipline studies the main types of mechanisms of robots and manipulators: hinge–lever, cam and gear mechanisms. The structural, kinematic and dynamic analysis and synthesis of various mechanisms of robots and manipulators, and their kinematic and dynamic properties are considered. Practical methods of solving problems of analysis and synthesis of mechanisms of robots and manipulators are studied. | 5 | | | | | V | | | |
| 42 | Noise immunity and security of infocommunication systems | Noise immunity and security of infocommunication systems. Methods of signal transmission via communication channels. Distortion in the communication channels. Selective interference in wired communication channels. Pulse interference. Causes of pulse interference. The influence of interference on the accuracy of the transmission of discrete information. The effect of short-term interruptions on the accuracy of the transmission of discrete information. The effect of fluctuation and pulse interference on the throughput of feedback systems. | 5 | | | | | | V | | |
| 43 | Basics of laser scanning of the Earth | The course examines the technological foundations of laser scanning, the general principles of the measurement process with laser scanners, the mathematical foundations of the measurement process, photogrammetric principles of data processing of ground-based laser scanning, evaluation of the accuracy of the construction of topographic products, the use of the Cyclone 4.1 Leica Geosystems software package for processing the results of ground-based laser scanning. | 5 | | | | | V | | | |
| 44 | CAD tools for space system design | The course examines the ways of automating the design of space systems, modern information technologies for design automation, methods of structural and parametric description of the design object, models of the functioning of design objects and principles of building an automatic design system for rocket and space technology. The requirements of the international ECSS standards for the design of space systems. | 5 | | | | | | V | | V |

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| | | Composition and purpose of ADEM modules 7.1. Flat modeling based on 3D models. Features of the application of the Pro/Engineer software and hardware complex for the design of rocket and space technology in CAD applications. | | | | | | | | | |
| 45 | Dynamics of remote sensing spacecraft motion control | The course examines the basic laws of celestial mechanics, motion in a gravitational field, integrals of spacecraft motion, the equation of spacecraft orbit, undisturbed and perturbed spacecraft motion, problems of ideal motion correction, determination of spacecraft spatial coordinates, consideration of the influence of external factors on spacecraft motion. | 5 | | | | | | | V | V |
| 46 | Operation of the ground receiving and transmitting segment | The course examines the technological features of the ground operation of space assets, space assets and their structure, the functions of the rocket and space complex, the cosmodrome and its infrastructure, the system of operation of space assets, methods of ensuring the efficiency of operational assets, ways to ensure the reliability of space assets, ways to improve the environmental friendliness of space assets, issues of automation of space assets operation management. | 5 | | | | | | | | V |
| 47 | Design of remote sensing space systems | The course examines ways to equip CS with both radar and optical equipment with high spatial resolution. Space systems equipped with optical equipment for studying the earth's natural resources LANDSAT, SPOT, RESURS – 0, IRS and ADEOS. Radar systems for ERS, Envisat – 1, RADARSAT remote sensing systems. The main provisions of the ST RK ECSS-E-ST-10C-2011 "Space engineering. Space development, design. System Design" | 5 | | | | | | | V | V |
| 48 | Fundamentals of mechatronic systems modeling | The course studies the modeling and programming of automatic, mechatronic and robotic systems. Formation of knowledge, skills and abilities in the field of modern methods and means of modeling systems of various physical nature, which are necessary for the successful solution of problems of development, research and operation of mechatronic and robotic systems, systems of automatic and automated control of technical facilities and technological lines. Methods of modeling mechatronic systems in the MATLAB environment (Simulink/SimMechanics) | 5 | | | | V | | V | | |
| 49 | Spatial data | Data entry, preprocessing and storage. Data sources. Spatial | 5 | | | | | V | | V | |

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| | infrastructure | data models. Analog-to-digital data conversion. Databases and their management. Methods of spatial and temporal modeling . Data classification. GIS and remote sensing. Virtual-reality images. GIS and global positioning systems. GIS and the Internet. Artificial intelligence technologies and expert systems. Spatial data infrastructure. Implementation of geoinformation projects. | | | | | | | | | |
| 50 | Actuators of automation systems | The course covers general information about actuators, classification, requirements for them, and their functional characteristics. Pneumatic actuators, hydraulic actuators, electric actuators, controlled control and pipe fittings and their schematic diagrams. | 5 | | | | | V | | | V |
| 51 | Spacecraft power supply systems | The course examines various sources of the spacecraft power supply system, such as solar panels, rechargeable batteries, fuel cells, and nuclear power plants. Energy consumers on board the spacecraft. A simulation model of energy supply. Issues of selection and design of Spacecraft power supply systems. Issues of utilization of energy sources. | 5 | | | | | | V | | V |
| 52 | Spacecraft temperature control systems | The course examines various sources of the spacecraft power supply system, such as solar panels, rechargeable batteries, fuel cells, and nuclear power plants. Energy consumers on board the spacecraft. A simulation model of energy supply. Issues of selection and design of Spacecraft power supply systems. Issues of utilization of energy sources. | 5 | | | | | | V | | V |
| 53 | TRIZ in the space industries | The discipline is designed to solve problems arising in the development, design and operation of new innovative equipment and technologies in the space industry. Familiarization with 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 engineering tasks set for the space industry. | 5 | | | | V | | | | |
| 54 | Fundamentals of space activity management | The discipline studies the main provisions of project quality management systems in the space industry in accordance with | 5 | | | | | | V | | |

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| | | international ISO standards. The life cycle of a space project. Risk management analysis of space projects. A conceptual approach to risk management of space projects. Risk management tools for space projects. | | | | | | | | | |
| 55 | Knowledge engineering and intelligent systems | The purpose of the course is to develop students' practical skills in engineering analysis and design, the formulation and conduct of scientific research, including the formation of students' professional orientation as a personality quality of a future engineer | 5 | | | | | V | | | |
| 56 | Intelligent positioning systems | Global satellite navigation systems. Elements and principles of GNSS functioning. The structure of the radio signal and its distorting factors. Intelligent self-learning systems to improve positioning accuracy. Real-time positioning technologies. Automated positioning systems. | 5 | | | | | | V | | |
| 57 | M2M and Internet of Things Networks | The course outlines the procedure, provides information about the main stages and stages of design, content and features of individual stages. When designing, it is assumed that all technical decisions, from the development of a mathematical model to the detailing of the structure, should be made based on the need to optimize the entire system according to accepted efficiency criteria. | 5 | | | | V | | | | |
| 58 | Intelligent recognition systems | Fundamentals of methods for recognizing and restoring two-dimensional and three-dimensional images. The main approaches to solving image processing problems. Software-analytical recognition methods. Working with the image archive. Methods of intelligent self-learning systems when working with data centers. Methodology application of deep learning and computer vision in intelligent recognition systems. | 5 | | | | | V | | | |
| 59 | Industrial practice I | The main purpose of industrial practice I is to provide students of the Space Engineering and Technology Department with the opportunity to apply their knowledge, skills and abilities in a real work environment. The production practice is aimed at gaining practical experience in the development and design of individual elements of space technology and technology. Production practice is carried out in companies and organizations engaged in direct development and design, maintenance of elements of space technology and the creation | 2 | | | | | | V | | |

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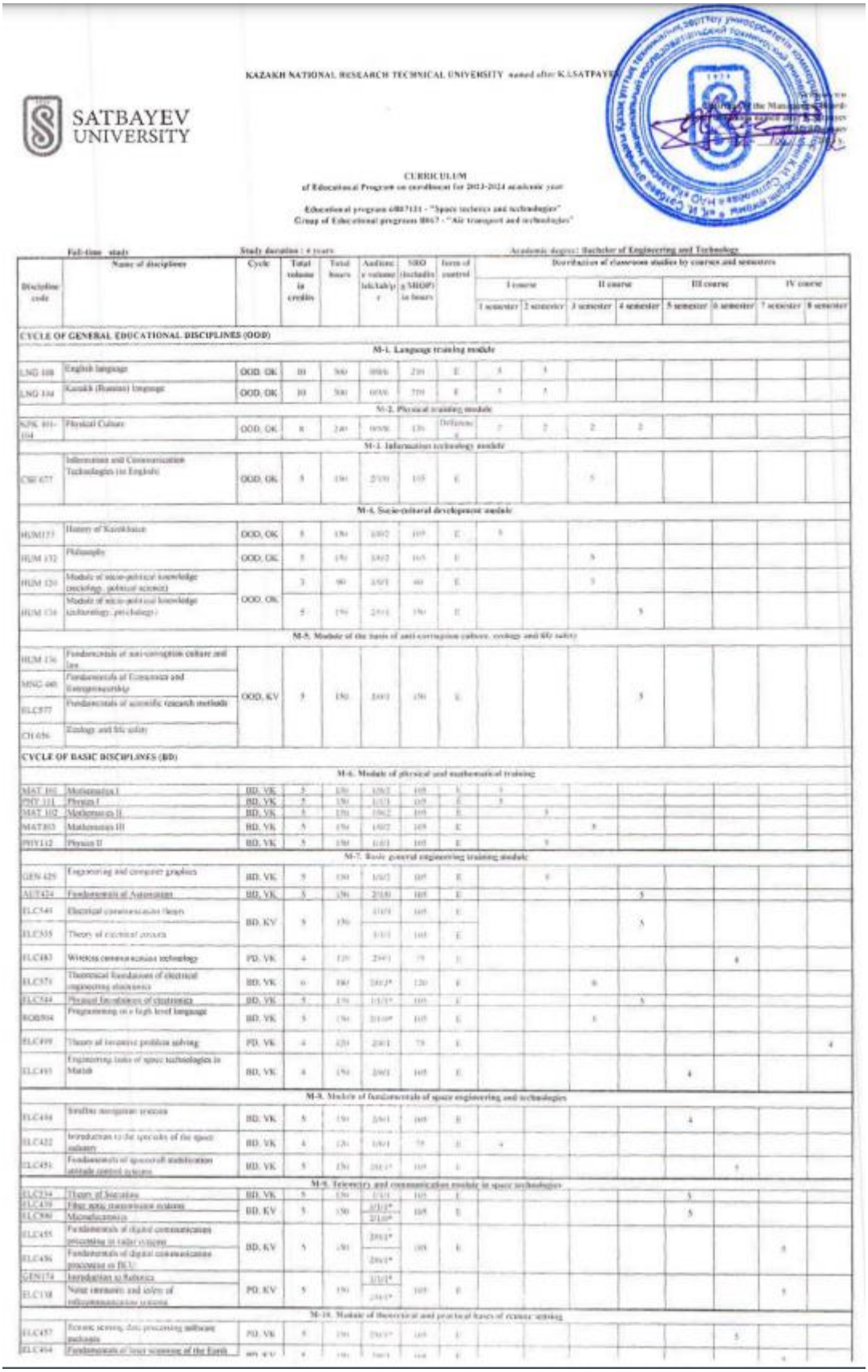
| | | of new types of technology, such as (KTiT LLP, Galam LLP, NCKIT, FTI JSC, KGS JSC, RCCC JSC, etc. | | | | | | | | | |
| 60 | Industrial practice II | The main purpose of the industrial practice II is to provide students with the experience of working in real infrastructure facilities of the space industry, as well as in expanding projects of space systems for remote sensing of the Earth. The tasks of the practice include working in a team on real innovative developments, and harmonizing graduation topics with real projects of the organization, including calculations, drawing up algorithms, direct participation in research projects, in the analysis of the data obtained, as well as communication skills of the production and research environment, teamwork skills. | 3 | | | | | | | | V |

# 5. The curriculum of the educational program



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

SATBAYEV UNIVERSITY

CURRICULUM

of Educational Program on enrollment for 2023-2024 academic year

Educational program 6B07121 - "Space technics and technologies"
Group of Educational programs B067 - "Air transport and technologies"

Full-time study | Study duration : 4 years | Academic degree: Bachelor of Engineering and Technology

| Discipline code | Name of discipline | Cycle | Total volume in credits | Total hours | Audit. volume (lect./lab./p.) | SRO (including SRDP) in hours | Form of control | Distribution of classroom studies by courses and semesters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | I course | | II course | | III course | | IV course | |
| | | | | | | | | 1 semester | 2 semester | 3 semester | 4 semester | 5 semester | 6 semester | 7 semester | 8 semester |
| **CYCLE OF GENERAL EDUCATIONAL DISCIPLINES (OOD)** | | | | | | | | | | | | | | | |
| **M-1. Language training module** | | | | | | | | | | | | | | | |
| LNG 108 | English language | OOD, OK | 10 | 300 | 0/0/6 | 210 | E | 5 | 5 | | | | | | |
| LNG 104 | Kazakh (Russian) language | OOD, OK | 10 | 300 | 0/0/6 | 210 | E | 5 | 5 | | | | | | |
| **M-2. Physical training module** | | | | | | | | | | | | | | | |
| KPK 101-104 | Physical Culture | OOD, OK | 8 | 240 | 0/0/8 | 120 | Difference | 2 | 2 | 2 | 2 | | | | |
| **M-3. Information technology module** | | | | | | | | | | | | | | | |
| CSE 677 | Information and Communication Technologies (in English) | OOD, OK | 5 | 150 | 2/3/0 | 105 | E | | | 5 | | | | | |
| **M-4. Socio-cultural development module** | | | | | | | | | | | | | | | |
| HUM173 | History of Kazakhstan | OOD, OK | 5 | 150 | 3/0/2 | 105 | E | 5 | | | | | | | |
| HUM 172 | Philosophy | OOD, OK | 5 | 150 | 3/0/2 | 105 | E | | | 5 | | | | | |
| HUM 120 | Module of socio-political knowledge (sociology, political science) | OOD, OK | 3 | 90 | 2/0/1 | 60 | E | | | 3 | | | | | |
| HUM 124 | Module of socio-political knowledge (culturology, psychology) | | 5 | 150 | 2/0/3 | 150 | E | | | | 5 | | | | |
| **M-5. Module of the basis of anti-corruption culture, ecology and life safety** | | | | | | | | | | | | | | | |
| HUM 126 | Fundamentals of anti-corruption culture and law | OOD, KV | 5 | 150 | 2/0/3 | 150 | E | | | | 5 | | | | |
| MNG 446 | Fundamentals of Economics and Entrepreneurship | | | | | | | | | | | | | | |
| ELC577 | Fundamentals of scientific research methods | | | | | | | | | | | | | | |
| CH 656 | Ecology and life safety | | | | | | | | | | | | | | |
| **CYCLE OF BASIC DISCIPLINES (BD)** | | | | | | | | | | | | | | | |
| **M-6. Module of physical and mathematical training** | | | | | | | | | | | | | | | |
| MAT 101 | Mathematics I | BD, VK | 5 | 150 | 1/0/2 | 105 | E | 5 | | | | | | | |
| PHY 111 | Physics I | BD, VK | 5 | 150 | 1/1/1 | 105 | E | 5 | | | | | | | |
| MAT 102 | Mathematics II | BD, VK | 5 | 150 | 1/0/2 | 105 | E | | 5 | | | | | | |
| MAT103 | Mathematics III | BD, VK | 5 | 150 | 1/0/2 | 105 | E | | | 5 | | | | | |
| PHY112 | Physics II | BD, VK | 5 | 150 | 1/1/1 | 105 | E | | 5 | | | | | | |
| **M-7. Basic general engineering training module** | | | | | | | | | | | | | | | |
| GEN 425 | Engineering and computer graphics | BD, VK | 5 | 150 | 1/0/2 | 105 | E | | 5 | | | | | | |
| AUT424 | Fundamentals of Automation | BD, VK | 5 | 150 | 2/1/0 | 105 | E | | | | 5 | | | | |
| ELC340 | Electrical communication theory | BD, KV | 5 | 150 | 2/1/1 | 105 | E | | | | 5 | | | | |
| ELC335 | Theory of electrical circuits | | | | 2/1/1 | 105 | E | | | | | | | | |
| ELC483 | Wireless communication technology | PD, VK | 4 | 120 | 2/0/1 | 75 | E | | | | | | 4 | | |
| ELC571 | Theoretical foundations of electrical engineering electronics | BD, VK | 6 | 180 | 2/0/3* | 120 | E | | | 6 | | | | | |
| ELC544 | Physical foundations of electronics | BD, VK | 5 | 150 | 1/1/3* | 105 | E | | | | 5 | | | | |
| ROB504 | Programming on a high level language | BD, VK | 5 | 150 | 2/1/0* | 105 | E | | | 5 | | | | | |
| ELC499 | Theory of inventive problem solving | PD, VK | 4 | 120 | 2/0/1 | 75 | E | | | | | | | | 4 |
| ELC493 | Engineering tasks of space technologies in Matlab | BD, VK | 4 | 150 | 2/0/1 | 105 | E | | | | | 4 | | | |
| **M-8. Module of fundamentals of space engineering and technologies** | | | | | | | | | | | | | | | |
| ELC444 | Satellite navigation systems | BD, VK | 5 | 150 | 2/0/1 | 105 | E | | | | | 4 | | | |
| ELC422 | Introduction to the specialty of the space industry | BD, VK | 4 | 120 | 1/0/1 | 75 | E | 4 | | | | | | | |
| ELC451 | Fundamentals of spacecraft stabilization attitude control systems | BD, VK | 5 | 150 | 2/1/1* | 105 | E | | | | | | 5 | | |
| **M-9. Telemetry and communication module in space technologies** | | | | | | | | | | | | | | | |
| ELC334 | Theory of Satellites | BD, VK | 5 | 150 | 1/1/1 | 105 | E | | | | | 5 | | | |
| ELC439 | Fiber optic transmission systems | BD, KV | 5 | 150 | 2/1/2* | 105 | E | | | | | 5 | | | |
| ELC440 | Microelectronics | | | | 2/1/0* | | | | | | | | | | |
| ELC455 | Fundamentals of digital communication processing in radio systems | BD, KV | 5 | 150 | 2/0/1* | 105 | E | | | | | | | 5 | |
| ELC456 | Fundamentals of digital communication processes in BLU | | | | 2/0/1* | | | | | | | | | | |
| GEN174 | Introduction to Robotics | PD, KV | 5 | 150 | 1/1/1* | 105 | E | | | | | | | 5 | |
| ELC138 | Noise immunity and safety of telecommunication systems | | | | 2/0/1* | | | | | | | | | | |
| **M-10. Module of theoretical and practical bases of remote sensing** | | | | | | | | | | | | | | | |
| ELC457 | Remote sensing, data processing software packages | PD, VK | 5 | 150 | 2/0/1* | 105 | E | | | | | | 5 | | |
| ELC454 | Fundamentals of space scanning of the Earth | PD, KV | 4 | 150 | 2/0/1 | 105 | E | | | | | | | 5 | |

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| ELC462 | CAD tools for space systems design | | | | | | | | | | | | | | | |
| ELC463 | Dynamics and motion control of remote sensing spacecraft | PD, KV | 5 | 150 | 2/0/1 | 105 | E | | | | | 5 | | | | |
| ELC465 | Operation of the ground receiving-transmitting services | | | | | | | | | | | | | | | |
| ELC459 | Design of space remote sensing systems | | | | | | | | | | | | | | | |
| ELC460 | Fundamentals of modeling mechatronic systems | PD, KV | 5 | 150 | 2/0/1 | 105 | E | | | | | | | 5 | | |
| M-11. Space image processing module | | | | | | | | | | | | | | | | |
| CSE481 | Methods for decoding space images | PD, VK | 5 | 150 | 2/1/0 | 105 | E | | | | | | 5 | | | |
| ELC450 | Remote sensing data interpretation methods | PD, VK | 5 | 150 | 2/0/1 | 105 | E | | | | | | 5 | | | |
| M-12. Spatial Data Infrastructure Module and Automation | | | | | | | | | | | | | | | | |
| ELC449 | Fundamentals of GIS technology | BD, VK | 5 | 150 | 2/0/1 | 105 | E | | | | | 5 | | | | |
| ELC498 | Spatial Data Infrastructure | BD, KV | 5 | 150 | 2/0/1* 2/1/0* | 105 | E | | | | | | 5 | | | |
| AUT409 | Actuators of automation systems | | | | | | | | | | | | | | | |
| M-13. Power supply and thermal control module for space systems | | | | | | | | | | | | | | | | |
| ELC466 | Spacecraft power supply systems | PD, KV | 5 | 150 | 2/0/1 | 105 | E | | | | | | | | | 5 |
| ELC467 | KA thermal control systems | | | | | | | | | | | | | | | |
| M-14. Creativity Development and Project Management Module | | | | | | | | | | | | | | | | |
| ELC495 | TIPS in space technology | BD, KV | 4 | 150 | 2/0/1 | 105 | E | | | | | | | 4 | | |
| ELC496 | Fundamentals of space project management | | | | | | | | | | | | | | | |
| M-15. Intelligent systems module in space technologies | | | | | | | | | | | | | | | | |
| ELC497 | Intelligent systems in space technologies | PD, VK | 4 | 150 | 1/2/0 | 105 | E | | | | | | | 4 | | |
| ELC272 | Knowledge Engineering and Intelligent Systems | PD, KV | 5 | 150 | 2/0/1 | 105 | E | | | | | | | | | 5 |
| ELC447 | Intelligent positioning systems | | | | | | | | | | | | | | | |
| ELC432 | M2M networks and the Internet of things | PD, KV | 5 | 150 | 2/0/1 | 105 | E | | | | | | | | | 5 |
| ELC446 | Intelligent recognition systems | | | | | | | | | | | | | | | |
| ELC507 | Smart Grids | PD, VK | 5 | 150 | 2/0/1 | 105 | E | | | | | | | | | 5 |
| M-16. Practice-oriented module | | | | | | | | | | | | | | | | |
| AAP179 | Educational practice | BD, VK | 2 | | | | | | 3 | | | | | | | |
| AAP143 | Field trip I | PD, VK | 2 | | | | | | | | 2 | | | | | |
| AAP169 | Field trip II | PD, VK | 3 | | | | | | | | | | 3 | | | |
| M-17. Final assessment module | | | | | | | | | | | | | | | | |
| ECA108 | Final examination | FE | 8 | | | | | | | | | | | | | 8 |
| M-18. Module of additional types of training | | | | | | | | | | | | | | | | |
| AAP500 | Military training | DVO | 0 | | | | | | | | | | | | | |
| | Total for UNIVERSITY: | | | | | | | 31 | 29 | 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 | university component | elective component | Total |
| GED | Cycle of general education disciplines | 51 | | 5 | 56 |
| BD | Cycle of basic disciplines | | 82 | 31 | 170 |
| PD | Cycle of profile disciplines | | 28 | 33 | |
| | *Total for theoretical training:* | *51* | *110* | *67* | *232* |
| FA | Final attestation | 8 | | | 8 |
| | TOTAL: | 59 | 110 | 67 | 240 |

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol №5 от "24" 11 2022 г.

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

Decision of the Academic Council of the Institute of Automation and Information Technologies. Protocol №2 от 20.09 2022.

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

Director of the Institute of AaIT — R.K. Uskenbayeva

Head of the department "ETaST" — E. Tashtay

Representative of the Council from employers — A.S. Inchin