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

# EDUCATIONAL PROGRAM
# 6B07303 - «Geospatial digital Engineering»

Code and classification of the field of education: 6B07 Engineering Manufacturing and Civil engineering
Code and classification of training directions: 6B073 Architecture and Civil engineering
Group of educational programs: B074 Urban planning, construction work and civil engineering
Level based on NQF:6
Level based on IQF:6
Study period: 4 years
Amount of credits: 240

**Almaty 2024**

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

Educational program 6B07303 - «Geospatial digital Engineering» was approved at a meeting of the Academic Council of KazNRTU named after K.I.Satpayev.
Protocol № 6 of 19.04.2024
Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after K.I.Satpayev.
Protocol № 12 of 22.04.2024

Educational program 6B07303 - «Geospatial digital Engineering» developed by the academic committee in the direction of «Geospatial digital Engineering»

| Full name | Academic degree/ academic title | Position | Place of work | Signature |
|---|---|---|---|---|
| **Chairman of the Academic Committee:** | | | | |
| Kochetova M.A. | | director | «Leica Geosystems Kazakhstan» | |
| **Academic staff:** | | | | |
| Orynbassarova E.O. | PhD | head of department | SU | |
| Kassymkanova Kh.M. | d.t.s | professor | SU | |
| Nukarbekova Zh.M. | m.s.c. | senior lecturer | SU | |
| **Employer:** | | | | |
| Narbaev M.M. | | director | TOO «ALIGeo» | |
| **student:** | | | | |
| Tursynkyzy M. | | 4th year student | | |



F KazNRTU 703-05 Educational program

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## List of abbreviations and symbols

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

## 1. Description of the educational program

The Geospatial Digital Engineering educational program is a first-level qualification of three levels of the higher education system. At the expense of the qualification module and final qualification work of bachelors of the educational program.

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

**Goal EP:** The purpose of the educational program is to prepare a graduate as a competitive specialist in the field of geodesy and cartography, possessing critical thinking, able to use theoretical and practical information to perform geodetic, topographic, astronomical-geodetic, photogrammetric and cartographic work using modern geodetic equipment and geospatial digital technologies for solving applied problems.

**Tasks EP**:

Task 1: preparing graduates for organizational activities that exclude negative phenomena in professional activity, the development of spiritual values, moral and ethical norms of a person as a member of society, the execution of the legal and legislative system of the Republic of Kazakhstan with a high level of professional culture, civic position;

Task 2: preparing graduates for continuous self-improvement and self-development, mastering new knowledge, skills and abilities in innovative areas of geodesy and cartography;

Task 3: preparation of a graduate with acquired competencies for performing calculations of elements in geodesy and cartography, design of technical solutions, participation in the development of technical tasks for topographic, geodetic, aerospace, cartographic work on the basis of modern educational material and technical base;

Task 4: preparation of a graduate, based on the diversity and dynamism of the catalog of elective disciplines of the curriculum, with a predominance of practical skills in competencies, capable of performing professional functions

within one or more types of activities based on the final results of training, taking into account the specifics of these activities, market requirements for organizational and managerial, professional competencies;

Task 5: training of graduates as a competitive specialist in the field of geodesy and cartography, including on the basis of increasing the international aspect in educational and scientific programs, competent in the field of advanced technologies of geodesy, cartography, and registration of research results.

## 3. Requirements for the evaluation of learning outcomes of the educational program

Learning outcomes include knowledge, skills and competencies and are defined both for the educational program as a whole and for its individual modules, disciplines or tasks.

The main task at this stage is to select assessment methods and tools for all types of control, with the help of which it is possible to most effectively assess the achievement of planned learning outcomes at the discipline level.

## 4. Passport of the educational program

### **4.1** General information

| № | Field Name | Note |
|---|---|---|
| 1 | Code and classification of the field of education | 6B07 Engineering, Manufacturing and Civil engineering |
| 2 | Code and classification of training directions | 6B073 Architecture and civil engineering |
| 3 | Educational program group | B074 Urban Planning, construction works and Civil engineering |
| 4 | Educational program name | 6B07303 Geospatial Digital Engineering |
| 5 | Short description of educational program | Educational program "Geospatial Digital Engineering" – This is a first-level qualification of the three levels of higher education. |
| 6 | Purpose of EP | The purpose of the educational program is to prepare a graduate as a competitive specialist in the field of geodesy and cartography, possessing critical thinking, able to use theoretical and practical information to perform geodetic, topographic, astronomical-geodetic, photogrammetric and cartographic work using modern geodetic equipment and geospatial digital technologies for solving applied problems. |
| 7 | Type of EP | New EP |
| 8 | The level based on NQF | 6 |
| 9 | The level based on IQF | 6 |
| 10 | Distinctive features of EP | No |
| 11 | List of competencies of educational | 12 |

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| | program | |
| 12 | Learning outcomes of educational program | 1. To form the ability to communicate orally and in writing in the state, Russian and foreign languages to solve the problems of interpersonal and intercultural interaction<br>2. To form an understanding of the essence and meaning of information in the development of modern society, the ability to receive and process information from various sources, the willingness to interpret, structure and formalize information in a form accessible to others.<br>3. To discuss the main stages and patterns of the historical development of society for the formation of a civic position.<br>4. To explain the basics of philosophical knowledge for the formation of a worldview position.<br>5. Demonstrate proficiency in professional communication techniques, ability to work in a team, tolerance of perception of social, ethnic, confessional and cultural differences, awareness of the need to study independently and improve their skills throughout their working life.<br>6. Apply the basics of mathematical knowledge in geodesy and cartography to solve applied problems using Matlab.<br>7. Apply remote sensing data of the Earth in solving applied geodetic, cadastral and land management tasks; perform aerial photography of land plots using unmanned aerial vehicles; apply GIS technologies when creating maps, various subjects, digital models of terrain and objects.<br>8. Demonstrate knowledge in the field of creating digital models and modeling to automate the processing process based on remote sensing data, mathematical interpretation and the use of algorithms, programs for solving geodesy problems and creating maps and designing cartographic materials in a web environment, use web architecture systems and algorithms when designing maps and building web applications, creating interactive maps.<br>9. Apply the methods of modern geoinformation technologies in the development of digital maps, conceptual and terminological apparatus of cartography in the design and computer design of maps.<br>10. Demonstrate knowledge in the field of WEB-geoinformatics and modern geoinformation technologies for solving professional geodetic and cartographic tasks; use ENVI programs for |

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| | | photogrammetric image processing, ArcGIS and QGIS for image classification; create orthophotoplanes and digital terrain models based on UAV data.<br>11. Demonstrate a wide range of theoretical and practical knowledge in the professional field, the ability to develop, implement and control the quality and completeness of projects of high-precision and applied geodetic works.<br>12. Demonstrate mastery of geodetic, photogrammetric and cartographic methods; technical means of space geodesy; computer technology and automated processing of geodetic, cadastral, land management information.<br>13. To form the ability to carry out the main technological processes of topographic and geodetic, aerial photogrammetric and cartographic works and the ability to calculate the technical and economic efficiency when choosing technical and organizational solutions for topographic and geodetic and cartographic production.<br>14. Apply modern technologies for obtaining field geodetic information for mapping the territory of the country and updating the existing cartographic fund.<br>15. Apply ground-based and satellite positioning technologies for geodetic support of construction of engineering structures; process satellite observation data in professional software products; perform laser scanning to create high-precision three-dimensional models of industrial facilities for their inclusion in corporate management systems, construction and control, operational monitoring of particularly important objects and hazardous areas, calculation of volumes of displaced soil, movement slopes, etc. |
| 13 | Education form | Full-time |
| 14 | Period of training | 4 years |
| 15 | Amount of credits | 240 |
| 16 | Languages of instruction | Russian, Kazakh |
| 17 | Academic degree awarded | Bachelor |
| 18 | Developer(s) and authors | Department MSaG |

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

| № | Name of the discipline | Short description of the discipline | Number of credits | Generated learning outcomes (codes) | | | | | | | | | | | | | | |
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| | | | | LR1 | LR2 | LR3 | LR4 | LR5 | LR6 | LR7 | LR8 | LR9 | LR10 | LR11 | LR12 | LR13 | LR14 | LR15 |
| **Cycle of general education disciplines<br>University component** | | | | | | | | | | | | | | | | | | |
| 1 | Foreign language | English is a compulsary subject. According to the results of placement test or IELTS score, students are placed into groups and disciplines. The name of the discipline corresponds to the level of English.<br>When passing from level to level, prerequisites and postrequisites are respected. | 5 | v | | | | | | | | | | | | | | |
| 2 | Kazakh (russian) language | Kazakh (Russian) language<br>In this course author considers socio-political, socio-cultural spheres of communication and functional styles of the modern kazakh (russian) language. The course covers the specifics of the scientific style to develop and activate professional communication skills and abilities of students. Also it allows students to leavn the basics of scientific style practically and develop the ability of production | 5 | v | | | | | | | | | | | | | | |

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| | | structural and semantic text analysis. | | | | | | | | | | | | | | | | |
| 3 | Physical culture | The purpose of the discipline is to master the forms and methods of forming a healthy lifestyle within the framework of the professional education system. Familiarization with the natural-scientific basics of physical education, knowledge of modern health-improving technologies, basic methods of independent physical education and sports. As part of the course, the student will master the rules of judging in all sports. | 8 | v | | | | | | | | | | | | | | |
| 4 | Information and communication technology | The aim of the course is to gain theoretical knowledge in information processing, the latest information technologies, local and global networks, the methods of information protection; Getting the right use of text editor editors and tabulators; creation of base and different categories of applications. | 5 | | | | v | | | | | | | | | | | |
| 5 | History of Kazakhstan | The purpose of the discipline is to provide objective historical knowledge about the main stages of the history of Kazakhstan from ancient times to the present day; | 5 | | v | | | | | | | | | | | | | |

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| | | introduce students to the problems of the formation and development of statehood and historical and cultural processes; contribute to the formation of humanistic values and patriotic feelings in the student; teach the student to use the acquired historical knowledge in educational, professional and everyday life; evaluate the role of Kazakhstan in world history. | | | | | | | | | | | | | | | | | |
| 6 | Philosophy | The purpose of the discipline is to teach students the theoretical foundations of philosophy as a way of knowing and spiritually mastering the world; developing their interest in fundamental knowledge, stimulating the need for philosophical assessments of historical events and facts of reality, assimilating the idea of the unity of the world historical and cultural process while recognizing the diversity of their skills in applying philosophical and general scientific methods in professional activities. | 5 | | | | **v** | | | | | | | | | | | | |
| 7 | Module of socio-political knowledge (sociology, | The objectives of the disciplines are to provide | 3 | | | | **v** | | | | | | | | | | | | |

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| | political science) | students with explanations on the sociological analysis of society, about social communities and personality, factors and patterns of social development, forms of interaction, types and directions of social processes, forms of regulation of social behavior, as well as primary political knowledge that will serve as a theoretical basis for understanding social -political processes, for the formation of political culture, development of a personal position and a clearer understanding of the extent of one's responsibility; help to master the political, legal, moral, ethical and socio-cultural norms necessary to act in the interests of society, form personal responsibility and achieve personal success. | | | | | | | | | | | | | | | | | |
| 8 | Module of socio-political knowledge (cultural studies, psychology) | The purpose of the disciplines is to study the real processes of cultural creative activity of people who create material and spiritual values, identify the main trends and patterns of cultural development, changes in cultural eras, methods and styles, their role in the formation of man and the | 5 | | | **v** | | | | | | | | | | | | | |

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| | | development of society, as well as master psychological knowledge for the effective organization of interpersonal interaction, social adaptation in the field of their professional activities. | | | | | | | | | | | | | | | | |
| **General education curriculum<br>Elective component** | | | | | | | | | | | | | | | | | | |
| 9 | Fundamentals of anti-corruption culture and law | To increase the 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. Improvement of socio-economic relations of the Kazakh society, psychological features of corrupt behavior, formation of an anti-corruption culture, legal responsibility for acts of corruption in various fields.. | 5 | v | | | | | | | | | | v | | | | |
| 10 | Fundamentals of economics and entrepreneurship | To develop basic knowledge of economic processes and skills in entrepreneurial activities. The course aims to develop skills in analyzing economic concepts such as supply and demand, and market equilibrium. It includes the basics of creating and managing a business, | 5 | v | v | | | | | v | | | | | | | | | |

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| | | developing business plans, risk assessment, and strategic decision-making. | | | | | | | | | | | | | | | | |
| 11 | Basics of Financial Literacy | Formation of financial literacy of students on the basis of building a direct link between the acquired knowledge and their practical application. Using in practice all kinds of tools in the field of financial management, saving and increasing savings, competent budget planning, obtaining practical skills in calculating, paying taxes and correctly filling out tax reports, analyzing financial information, orienting in financial products to choose adequate investment strategies. | 5 | | | | | | | | | | | | | | | |
| 12 | Fundamentals of scientific research methods | The purpose of the discipline "Fundamentals of research methods" is the formation of students' skills and abilities in the field of methodology of scientific knowledge. Brief description of the discipline. Methodological foundations of scientific knowledge. The concept of scientific knowledge. Methods of theoretical and empirical research. Choice of the | 5 | v | | v | | | | | | | | | | | | |

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| | | direction of scientific research. Stages of research work. Research topic and its relevance. Classification, types and tasks of the experiment. Metrological support of experimental studies. Computational experiment. Methods for processing the results of the experiment. Formulation of research results. Presentation of research work. | | | | | | | | | | | | | | | | | |
| 13 | Ecology and life safety | Formation of ecological knowledge and consciousness, obtaining theoretical and practical knowledge on modern methods of rational use of natural resources and environmental protection. The study of the tasks of ecology as a science, 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, ways to solve environmental problems; life safety in the technosphere, emergencies of a natural and man-made nature. | 5 | v | | v | | | | | | | | | | | | | |

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| **Cycle of basic disciplines** | | | | | | | | | | | | | | | | | | |
| 14 | Higher geodesy | The aim is to study geodetic methods for creating a coordinate basis on the physical surface of the Earth to solve geodesy problems. To study the shape of the Earth, its gravitational field. To study the methods of high-precision geodetic measurements, mathematical processing of geodetic measurements in the creation, development and evaluation of the quality of construction of state geodetic structures | 5 | | | | **v** | | | | | | **v** | | | | | |
| 15 | Geodetic instruments | Of studying of discipline "Geodezicheskoe instrumentology" is the study of the design and technical features optical and mechanical surveying instruments, evaluate the accuracy of the instrument. The study of the full cycle (podgotovka, working and receiving data) work with geodetic instruments. Device and principle of operation of geodetic tools. Definition of precision, detection and komentiranje factors influencing the measurement accuracy. | 5 | | | | **v** | | | | | | **v** | | | | | |

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| | | Segments and types of modern GNSS receivers. Types of modern tools, their similarities and differences principially. | | | | | | | | | | | | | | | | |
| 16 | Geodesy | He will master the basic concepts of the Shape and size of the Earth, about coordinate systems used in geodesy, about the orientation of lines on the terrain, about plans, maps, profiles, about scale, terrain relief, about angular and linear measurements, about altitude measurements, about methods and measurements of topographic surveys, about the accuracy of geodetic measurements, the use of geodetic instruments, as well as cameral processing of the geodetic measurements obtained. | 6 | v | v | | | | | v | | | | | | | | |
| 17 | Geoinformatics | Formation of a complex of knowledge in the field of using GIS, when creating digital models, acquiring knowledge and skills in using modern GIS in various types of professional and social activities. Master the methods of creating topographic maps and plans using GIS technology, the principles of creating databases, gain skills | 5 | | | | v | | | | | | v | | | | | |

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| | | in creating GIS using materials from aerospace and ground surveys. | | | | | | | | | | | | | | | | |
| 18 | Gravimetry | The purpose of the discipline is to study methods for determining the characteristics of the Earth's gravitational field in order to use them in solving scientific and practical problems of geodesy, geophysics and geology. Theory of the Earth's gravitational field, determination of the Earth's surface and gravitational field from measurements of gravity, measurement of gravity and second derivatives of the gravity potential, study of gravimeters and laying out gravimetric passages, processing of measurement results and assessment of their accuracy, application of gravimetry in solving geodetic problems. | 5 | | | v | | | | | | | | | v | | | |
| 19 | Engineering geodesy | Formation of theoretical knowledge and practical skills in the field of obtaining, processing and using geodetic information as the initial basis for decision-making and implementation in the design, construction and operation of | 5 | | | | | v | | | | v | | | | | | |

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| | | engineering systems It contains a full range of topics on methods and means of production of geodetic measurements on the Earth's surface, aimed at forming the foundations of engineering geodesy as a modern complex fundamental science, and at developing skills in using ready-made planning and topographic materials in solving engineering and practical problems. | | | | | | | | | | | | | | | | | |
| 20 | Engineering surveying linear structures | To form theoretical knowledge and practical skills in the field of obtaining, processing and using geodetic information as the initial basis for making and implementing decisions in the design, construction and operation of engineering linear structures, the creation of geodetic plans. To master modern methods of performing geodetic works carried out during surveys of linear structures, providing topographic and geodetic plans of various scales, profiles for the design, construction and reconstruction of linear structures. | 5 | v | | v | | | | | | | | | | | | | |

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| 21 | Engineering and computer graphics | To develop students' knowledge of drawing construction and skills in developing graphical and textual design documentation in accordance with standards. Students will study ESKD standards, graphic primitives, geometric constructions, methods and properties of orthogonal projection, Monge's projection, axonometric projections, metric tasks, types and features of connections, creating part sketches and assembly drawings, detailing, and creating complex 3D solid objects in AutoCAD. | 5 | v | | v | | | | | | | | | | | | | |
| 22 | Cartography | To study the mathematical basis of maps and types of cartographic projections. Be able to choose and justify the scale, recognize the map projection. Examine the distortions on the maps. To master the cartographic methods of depicting the relief. To study the main sources for compiling thematic and general geographical maps. Master the basic methods of creating maps in ArcGIS. | 5 | v | | v | | | | | | | | | | | | | |

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| 23 | Mathematics | The purpose of mastering the discipline is to form the theoretical and practical foundations of mathematics and its applications. On the basis of studying the mathematics section, to give students the development of thinking and the achievement of mathematical culture, which is necessary for application in future professional activities. The course is based on the study of mathematical analysis in a volume that allows you to study elementary functions and solve the simplest geometric, physical and other applied problems. The main focus is on differential and integral calculus. The course sections include the differential calculus of functions of one variable, the derivative and differentials, the study of the behavior of functions, complex numbers, and polynomials. Indefinite integrals, their properties and methods of calculation. Certain integrals and their applications. Improper integrals.. | 5 | | v | | | v | v | | | | | | | | | | |

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| 24 | Physics | The course studies 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 | | | | | v | | v | | | | | | | |
| 25 | Organization and planning of topographic and geodetic works | The discipline "Organization and planning of topographic and geodetic works" is the development of theoretical and practical foundations in the preparation and direction of requests to public authorities, local self-government.<br>Technical inventory for the provision of documents | 5 | | | | | | | | v | | | v | | | | |

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| | | necessary for the implementation of state cadastral registration and for the provision of information for decision-making based on the results of land cadastral procedures. | | | | | | | | | | | | | | | | |
| 26 | Applied geodesy | To study the methods of geodetic works when accompanying the design, construction and operation of engineering structures. Master the processing and evaluation of the accuracy of geodetic information and the construction of the initial basis on the construction site.<br>To analyze the composition and organization of geodetic works in the design of structures;<br>to argue for the use of methods and means when transferring the construction project to nature;<br>organize geodetic monitoring of buildings and structures during their operation. | 5 | v | | | | | | v | | | | | | | | |
| 27 | Theory of matematical processing og geodetic measurements | Students study methods of mathematical processing of the results of geodetic measurements, the ability to assess the accuracy of measurements, as well as | 5 | v | | v | | | | | | | | | | | | |

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| | | perform adjustment of geodetic constructions. As part of the course, the student must master the basics of probability theory, mathematical statistics and error theory in order to assess the quality of measurements performed and pre-calculate the accuracy of planned measurements, as well as gain skills in performing adjustments of geodetic networks based on the principle of least squares, parametric and correlated methods. | | | | | | | | | | | | | | | | |
| 28 | Topographical graphics | The discipline studies the theory and methods of graphic design of cartographic materials used in cartography, geodesy, land management, as well as the use of a graphic software package (CorelDRAW, AutoCAD, etc.). It also includes theoretical knowledge and practical skills in creating a topographic map, a land management plan, compiling and editing, preparing for publication and publishing maps, drawing and design work, for which it is necessary | 3 | | | v | | | | | | | | v | | | | |

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| | | not only to know the materials, drawing accessories and also to combine the methods and techniques of drawing and designing maps. | | | | | | | | | | | | | | | | |
| 29 | Digital mapping | Get theoretical knowledge and practical skills in using software for creating and updating digital cadastral plans and maps. To study methods for creating digital and electronic maps, as well as automation of cartographic support for land management work. To master the technology of creating digital topographic maps containing logical and mathematical descriptions of mapped objects and the relationship of terrain objects in the form of their combinations, intersections and neighborhoods. | 5 | | | v | | | | | v | v | v | | | | | |
| 30 | Architecture and building structures | The discipline studies the basic provisions of the design of buildings and structures, considers their classification, main parts and elements, structural systems and schemes, basic information about building structures, including the principles of their design, as well as | 5 | | | | | | | v | v | | | | | | | |

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| | | methods for calculating building structures. The main provisions of the calculation of structures for limiting states. | | | | | | | | | | | | | | | | |
| 31 | Technology of building manufacture I | The discipline studies the basic provisions of the construction industry, the most advanced methods of building processes; the main technologies for the erection of buildings and structures and the development of directive organizational and technological documentation on this informative basis. | 5 | | | | | | | v | v | | | | | | | |
| 32 | Geological disciplines | Geological disciplines Determination of the main ore-forming minerals (ores of non-ferrous, ferrous, rare metals); determination of minerals, determination of the main igneous, sedimentary and metamorphic rocks. In the process of studying this subject, the student should get an idea of the material composition of minerals, rocks, ores, the formation of MPI, the role of exogenous and endogenous processes in the formation of minerals, engineering and geological conditions of mineral deposits | 5 | | | | | | | | | | | | | v | v | |

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| | | and geological data necessary for the design of construction and operation Mountain constructions. | | | | | | | | | | | | | | | | |
| **Cycle of basic disciplines<br>Elective component** | | | | | | | | | | | | | | | | | | |
| 33 | Geodetic works at industrial sites of mines and quarries | To master the methods of conducting geodetic works on industrial sites of mines and quarries to create a reference and survey network. To learn how to perform a set of survey work for drawing up a master plan of the surface of a mineral deposit with an indication of the boundaries of mining and land allotments on it, ways of carrying out the design position of mining workings in kind, drawing up and processing the necessary reporting and graphic documentation. | 5 | | | | | v | v | | | | | | | | | |
| 34 | Fundamentals of sustainable development and ESG projects in Kazakhstan | The goal is for students to master the 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. Introduces the principles of | 5 | | | v | | | | | v | v | | v | | | | |

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| | | 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 in enterprises and organizations. | | | | | | | | | | | | | | | | |
| 35 | Geodetic and engineering surveying | To study the main types of topographic and geodetic works performed to ensure the design, construction and reconstruction of various structures, as well as to perform geological, hydrometeorological and other types of engineering surveys. To learn how to perform geodetic measurements when creating a planned, high-altitude justification for the design of engineering structures,to survey linear structures and underground utilities, to process the results of geodetic measurements and topographic surveys in order to build engineering plans and terrain profiles. | 5 | | | v | | | | | v | | | | | | | |
| 36 | Information technology in geodesy and remote sensing | Of studying the discipline is to prepare students to work with the basic algorithms for processing remote sensing | 5 | | v | | | | v | | | | | | | | | |

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| | | data. The student should know algorithms for working with large images and be able to apply Internet technologies for creating web services for storing and presenting spatial data. | | | | | | | | | | | | | | | | |
| 37 | Basics of laser scanning | To study the principle of operation of terrestrial laser scanners, the sources of errors in laser scanning and technological schemes of terrestrial laser scanning. To master the methods of external orientation of scans and the technique of laying scanner passages. Learn how to apply scanning technology in solving problems in geodesy, construction, architecture and in the oil and gas industry. | 6 | v | | v | | | | v | v | | | | | | | |
| 38 | Fundamentals of environmental mapping | To study technologies for creating ecological maps to support state and regional environmental programs. Get an idea about the parameters of environmental pollution sources. To master the methods of collecting, analyzing and cartographic data on the state of the natural environment and be able to create inventory-assessment, forecast, and control maps | 6 | | | | v | v | | | | | | v | v | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | using modern mapping technologies. | | | | | | | | | | | | | | | | |
| 39 | Legal regulation of intellectual property | The goal is to form a holistic understanding of the system of legal regulation of intellectual property, including basic principles, mechanisms for protecting intellectual property rights and features of their implementation. The discipline covers the basics of IP law, including copyright, patents, trademarks, and industrial designs. Students learn how to protect and manage intellectual property rights, and consider legal disputes and methods for resolving them. | 5 | | | | | | | | | | | | | | | |
| **Cycle of profile disciplines<br>University component** | | | | | | | | | | | | | | | | | | |
| 40 | Automation of topographic and geodetic works | Of studying the discipline is to obtain theoretical knowledge and practical skills on how to automate topographic and geodetic work in solving applied problems in the design and construction of engineering structures. Particular attention during the passage of this discipline is paid to the training of modern automated geodetic instruments, the study of the | 5 | | **v** | | | | **v** | **v** | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | principle of conducting topographic surveys using terrestrial laser scanning, the introduction of UAVs for the effective acquisition of geodetic data, as well as the use of satellite technologies. | | | | | | | | | | | | | | | | |
| 41 | Aerospace survey methods | Theoretical foundations of the application of aerospace survey methods to solve geodesy and cratography problems. The physical and geometric foundations of aerial surveys, platforms and sensors of space surveys of various ranges will be considered. Students will gain skills in processing aerospace images using various software products, learn how to perform georeferencing of images, classify depicted objects, and create orthophotomaps, digital terrain and relief models. | 5 | v | | | | | v | | | | | | | | | |
| 42 | Remote sensing of the earth | The purpose of the discipline is to master the methods of processing and analyzing satellite imagery data in solving cartographic, geodetic and environmental problems. Contents: Students will be able to understand the results of remote sensing of the Earth, | 6 | | | | v | | | | | | | v | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | use modern sensors operating in active and passive modes. They will master satellite imagery processing technology, including image enhancement and image interpretation methods, and learn how to select remote sensing data processing methods for solving geological and environmental problems. | | | | | | | | | | | | | | | | |
| 43 | Basics of the cadastre | The purpose is to systematize and record information about real estate in a certain territory, create a unified database of land plots and real estate objects, their owners, restrictions and encumbrances. Content: to master the procedure for conducting cadastral activities that allow you to fill out basic land cadastre documents. To study the regulatory framework, legal acts regulating the processes of cadastral activity. | 5 | | | | | | | v | | v | | v | | | | |
| 44 | Photogrammetry | To study the basics of the technology of modern photogrammetric processes, including methods for performing aerial surveys, their cameral processing, and analysis of the accuracy of the | 5 | | | | | v | v | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | obtained materials, as well as methods for using them to create and update topographic maps and cadastral plans. Apply modern technologies and software products in solving land management and cadastral tasks, as well as perform the optimal choice of satellite imagery materials and their integration into GIS programs when creating cadastral maps. | | | | | | | | | | | | | | | | |
| 45 | Space geodesy | A science that studies the use of the results of observations of artificial and natural satellites of the Earth to solve scientific and scientific-technical problems of geodesy. Creation of a global inertial reference frame based on space methods based on the position of extragalactic sources. Operational coordinate and time support of terrestrial objects by means of global navigation satellite systems. Coordinate-time support of space flights. The study of the shape of the Earth, Moon and planets using satellite measurements. | 5 | | | | | | | | | | | | | | v | v |
| 46 | Monitoring of deformations of structures | Geodynamics as scientific discipline. Modern value of | 5 | | | | | | | | v | v | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | geodynamics at various scales of its use (global, regional, local). Geodynamic tasks of geodesy. Classification of the geodynamic phenomena. Geodynamic grounds, their purpose and appointment. Research SGDZP on GDP. High-precision angular and linear measurements on GDP. Studying of SVDZK according to repeated leveling. GPS – supervision on GDP. | | | | | | | | | | | | | | | | |
| 47 | Global navigation satellite systems | To study the basic principles of satellite positioning technologies, absolute and relative methods of satellite measurements, the differential method of GNSS, as well as the specifics of the use of pseudo ranging and phase measurements. Familiarize yourself with the coordinate and time systems used in satellite observations. To master methods for calculating the instantaneous position of satellites and orbital parameters of satellites, as well as methods for calibrating and equalizing satellite measurements. Learn how to use GNSS | 4 | | | | | | | | | | | | | | v | v |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | observations to create satellite geodetic networks. | | | | | | | | | | | | | | | | |
| **Cycle of profile disciplines<br>Elective component** | | | | | | | | | | | | | | | | | | |
| 48 | Applied photogrammetry | Possess the theoretical foundations of photogrammetry, methods of photogrammetric processing of aerospace and ground images. Learn how to make topographic and cadastral plans based on aerospace survey data. Obtaining skills in modern photogrammetric software products. Be able to select space images of the required resolution, perform their primary processing and classification, as well as receive information about dynamic processes for solving environmental problems. Master the methodology of working with unmanned summer jobs. | 5 | | | | | | | | | | | | | | **v** | **v** |
| 49 | Fundamentals of digital photogrammetry | As part of the study of the discipline, students will study the theoretical foundations of photogrammetry, modern methods, systems and software products for digital photogrammetric processing and master the complex of knowledge necessary to use | 5 | | **v** | | | **v** | | **v** | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | digital photogrammetry methods to solve geodetic problems. Students will also learn how to perform photogrammetric processing of images in the ENVI program, perform image classification in ArcGIS and QGIS software, and process UAV data in the Agisoft program. | | | | | | | | | | | | | | | | |
| 50 | Web-GIS basics | Master the acquisition of theoretical and practical skills of working in WEB-geoinformation systems and modern geoinformation technologies. Possess the skills of using software and working in computer networks, the ability to create databases and use Internet resources, WEB portals, own software and software, GIS technologies, be able to work with information from various sources to solve professional and social problems. | 3 | | | | | v | v | v | | | | | | | | |
| 51 | Web-cartography | The concepts of map creation and map material design in a Web-oriented environment will be studied. The discipline is an alternative discipline to «Web-GIS basics». Gain skills in the use of the | 3 | | | | | | | | | | | | | | v | v |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | basics of computer networks and their mechanisms, and analyze the principles of GIS servers and JavaScript. Master the systems and algorithms of web architecture, in order to design and create interactive maps and web applications in the tasks of land management and cadastre. | | | | | | | | | | | | | | | | |
| 52 | Economics and management of cartographic production | The nature of the geographic data and the methods by which they are displayed on maps. Representation of spatial data. Preparation of the map and the process of digitization. Methods of cartographic images. Methods for input of vector data. Remote sensing as a special case of input raster data. Subsystem of storage and editing GIS. Cartographic overlay. Graphic errors in vector systems. Methods of drawing up, preparing for publication and issuing maps. Elementary spatial analysis. Measurement of lengths, perimeters, areas in raster and vector systems. Measures of form. | 5 | | | | | | | | | | | v | v | | | | |
| 53 | Economics and management | To form an idea of the | 5 | | | | | | | | | | | v | v | | | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | of topogeodetic production | economics of industrial production and methods of solving economic problems that arise in the process of topogeodesic and cartographic work. Be able to carry out calculations of economic efficiency and investment projects of engineering and geodetic works. Know the organization of product quality control in the main structural and auxiliary divisions of cartographic and geodetic enterprises, the standard structure of the financial management system of the cartographic and geodetic industry. | | | | | | | | | | | | | | | | |
| 54 | Geodetic support for the construction of unique buildings and structures | To study the methods of engineering and geodetic works for the maintenance and construction of the construction of unique buildings and structures. Know the regulatory documents on the production and accuracy of geodetic works during the construction and operation of unique buildings and structures. To master the methods of creation and technical characteristics of geodetic justification support | 5 | | | | | | | v | v | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | for the construction of unique buildings and structures. Be able to use high-precision geodetic instruments, perform center work and organize geodetic observations of deformations of unique structures | | | | | | | | | | | | | | | | |
| 55 | Thematic mapping | Of mastering the discipline "Information technologies in geodesy and remote sensing" is for students to acquire knowledge in the field of information technology, software and technological tools and their application in solving problems of geodesy and remote sensing. Methods of integrating remote sensing data into a GIS environment will be studied to solve practical and scientific problems of geodesy and cartography, including the creation of topographic and thematic maps for various purposes, as well as the study of environmental problems. | 5 | | | | | | v | v | | | | | | | | |

# 5. Curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board -
Rector of KazNRTU named after K.Satpayev
M.M. Dikambaev
2024 y.

CURRICULUM
of Educational Program on enrollment for 2024-2025 academic year
Educational program 6B07303 "Geospatial Digital Engineering"
Group of educational programs B074"Urban planning, construction and civil engineering"
Form of study: full-time Duration of study: 4 years Academic degree: Bachelor of Engineering and Technology

| Discipline code | Name of disciplines | Cycle | Total amount in credits | Total hours | Classroom amount lec/lab/pr | SIS (including TSIS) in hours | Form of control | Allocation of face-to-face training hours 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 EDUCATION DISCIPLINES (GED)** | | | | | | | | | | | | | | | |
| **M-1. Module of language training** | | | | | | | | | | | | | | | |
| LNG 108 | English language | GED, RC | 5 | 150 | 0/0/3 | 105 | E | 5 | | | | | | | |
| LNG 108 | English language | GED, RC | 5 | 150 | 0/0/3 | 105 | E | | 5 | | | | | | |
| LNG 104 | Kazakh (Russian) language | GED, RC | 5 | 150 | 0/0/3 | 105 | E | 5 | | | | | | | |
| LNG 104 | Kazakh (Russian) language | GED, RC | 5 | 150 | 0/0/3 | 105 | E | | 5 | | | | | | |
| **M-2. Module of physical training** | | | | | | | | | | | | | | | |
| KFK 101-104 | Physical Culture | GED, RC | 8 | 240 | 0/0/8 | 120 | Difcredit | 2 | 2 | 2 | 2 | | | | |
| **M-3. Module of information technology** | | | | | | | | | | | | | | | |
| CSE 677 | Information and communication technologies | GED, RC | 5 | 150 | 2/1/0 | 105 | E | | | | 5 | | | | |
| **M-4. Module of socio-cultural development** | | | | | | | | | | | | | | | |
| HUM 137 | History of Kazakhstan | GED, RC | 5 | 150 | 1/0/2 | 105 | SE | | 5 | | | | | | |
| HUM 132 | Philosophy | GED, RC | 5 | 150 | 1/0/2 | 105 | E | | | | 5 | | | | |
| HUM 120 | Socio-political knowledge module (sociology, politology) | GED, RC | 3 | 90 | 1/0/1 | 60 | E | | | | 3 | | | | |
| HUM 134 | Socio-political knowledge module (culturology, psychology) | GED, RC | 5 | 150 | 2/0/1 | 105 | E | | 5 | | | | | | |
| **M-5. Module fundamentals of anti-corruption culture, ecology and life safety** | | | | | | | | | | | | | | | |
| HUM 136 | Fundamentals of anti-corruption culture and law | GED, CCH | 5 | 150 | 2/0/1 | 105 | E | | | 5 | | | | | |
| MNG 489 | Fundamentals of Economics and entrepreneurship | | | | | | | | | | | | | | |
| HPP128 | Fundamentals of scientific research methods | | | | | | | | | | | | | | |
| CHE 656 | Ecology and life safety | | | | | | | | | | | | | | |
| **CYCLE OF BASIC DISCIPLINES (BD)** | | | | | | | | | | | | | | | |
| **M-6. Module of physical and mathematical training** | | | | | | | | | | | | | | | |
| MAT423 | Mathematics | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | 5 | | | | | | | |
| PHY 468 | Physics | BD, CCH | 5 | 150 | 1/1/1 | 105 | E | 5 | | | | | | | |
| **M-7. Module of basic training** | | | | | | | | | | | | | | | |
| GEN 429 | Engineering and computer graphics | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | 5 | | | | | | | |
| MAP570 | Topographic graphics | BD, CCH | 3 | 90 | 0/0/2 | 75 | E | 3 | | | | | | | |
| MAP536 | Geodesy | BD, CCH | 6 | 180 | 2/0/2 | 120 | E | | 6 | | | | | | |
| MAP537 | Cartography | BD, CCH | 6 | 180 | 2/0/2 | 120 | E | | | 6 | | | | | |
| **M-8. The module of engineering and geodetic works** | | | | | | | | | | | | | | | |
| MAP475 | Engineering geodesy | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | 5 | | | | | |
| MAP114 | Geoinformatics | BD, CCH | 5 | 120 | 1/0/2 | 75 | E | | | 5 | | | | | |
| MAP481 | Geodetic instrumentation | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | 5 | | | | |
| MAP477 | Digital mapping | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | 5 | | | | |
| MAP478 | Theory of mathematical processing of geodetic measurements | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | 5 | | | | |
| MAP488 | Organization and planning of topographic and geodetic works | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | 5 | | | |
| GEO474 | Geological disciplines | BD, CCH | 5 | 150 | 2/0/1 | 105 | E | | | | | 5 | | | |
| MAP480 | Engineering surveying linear structures | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | 5 | | | |
| CIV591 | Architecture and building structures | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | 5 | | | |
| MAP479 | Higher Geodesy | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | 5 | | | |
| CIV582 | Technology of construction production I | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | 5 | | |
| MAP482 | Gravimetry | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | 5 | | |
| MAP498 | Applied geodesy | BD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | 5 | |
| MAP556 | Basics of laser scanning | BC, CCH | 6 | 180 | 2/0/2 | 120 | E | | | | | | 6 | | |
| MAP555 | Fundamentals of environmental mapping | | | | 2/0/2 | | | | | | | | | | |
| MAP486 | Geodetic works on industrial sites of mines and quarries | BC, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | 5 | |
| MNG563 | Fundamentals of sustainable development and ESG projects in Kazakhstan | | | | 2/0/1 | | | | | | | | | | |
| MAP497 | Engineering and geodetic surveys | | | | 1/0/2 | | | | | | | | | | |
| MNG562 | Legal regulation of intellectual property | BC, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | 5 | |
| MAP473 | Information technology in geodesy and remote sensing | | 5 | 150 | 1/0/2 | 105 | | | | | | | | | |
| AAP173 | Educational practice | BD, CCH | 2 | | | | | | 2 | | | | | | |
| **CYCLE OF MAIN DISCIPLINES (PD)** | | | | | | | | | | | | | | | |
| **M-9. Professional activity module** | | | | | | | | | | | | | | | |
| MAP476 | The basics of the cadastre | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | 5 | | | | | |
| MAP155 | Photogrammetry | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | 5 | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAP483 | Aerospace survey methods | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | 5 | | |
| MAP541 | Remote sensing of the earth | PD, CCH | 6 | 180 | 2/0/2 | 120 | E | | | | | | 6 | | |
| MAP125 | Space geodesy | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | 5 | |
| **M-10. Geodetic works design module** | | | | | | | | | | | | | | | |
| MAP101 | Automation of topographic and geodetic works | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | 5 | |
| MAP137 | Monitoring of deformations of structures | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | | 5 |
| MAP544 | Global navigation satellite systems | PD, CCH | 4 | 150 | 1/0/2 | 75 | E | | | | | | | | 4 |
| MAP148 | Applied photogrammetry | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | 5 | |
| MAP198 | Fundamentals of digital photogrammetry | | | | 1/0/2 | | | | | | | | | | |
| MAP573 | Web-GIS basics | PD, CCH | 3 | 120 | 0/0/2 | 75 | E | | | | | | | | 3 |
| MAP571 | Web-cartography | | | | 0/0/2 | | | | | | | | | | |
| MAP543 | Economics and management of cartographic production | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | | 5 |
| MAP159 | Economics and management of topogeodetic production | | | | 1/0/2 | | | | | | | | | | |
| MAP467 | Geodetic support for the construction of unique buildings and structures | PD, CCH | 5 | 150 | 1/0/2 | 105 | E | | | | | | | | 5 |
| MAP422 | Thematic mapping | | | | 1/0/2 | | | | | | | | | | |
| AAP441 | Production practice I | PD, CCH | 7 | | | | | | | | 2 | | | | |
| AAP406 | Production practice II | PD, CCH | 7 | | | | | | | | | | 3 | | |
| **M-11. The module of final certification** | | | | | | | | | | | | | | | |
| ECA109 | Writing and defending a thesis (project) | FA | 8 | | | | | | | | | | | | 8 |
| **M-12. Module of additional types of training** | | | | | | | | | | | | | | | |
| AAP500 | Military training | ATT | 0 | | | | | | | | | | | | |
| **Total by UNIVERSITY:** | | | | | | | | 30 | 30 | 28 | 32 | 30 | 30 | 30 | 30 |
| | | | | | | | | 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 |
| ООД | Cycle of general education disciplines | 51 | | 5 | 56 |
| БД | Cycle of basic disciplines | | 97 | 16 | 176 |
| ПД | Cycle of profile disciplines | | 45 | 18 | |
| | *Total for theoretical training:* | | | | 232 |
| ИА | final attestation | 8 | | | 8 |
| | TOTAL: | | | | 240 |

**Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol № 12 от "22" 04 2024 y.**

**Decision of the Educational and Methodological Council of Kaz KazNRTU named after K.Satpayev. Protocol № 6 от "19" 04 2024 y.**

**Decision of the Academic Council of the Institute MMI Protocol № 8 от "17" 04 2024.**

**Vice-Rector for Academic Affairs** — **R.K.Uskenbayeva**

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

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

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