



**Institute of Architecture and construction named after T.K. Basenova  
Department of Engineering systems and networks**

**EDUCATIONAL PROGRAM  
«6B07306 Engineering systems and networks»**

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**


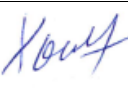

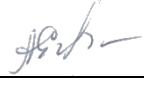


Educational program 6B07306 "Engineering systems and networks" was approved at the meeting of K.I. Satbayev KazNRTU Academic Council.

Minutes # 13 dated «28» 04 2022.

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council.

Minutes # 7 dated «26» 04 2022.

Educational program 6B07306 "Engineering systems and networks" was developed by Academic committee based on direction «Architecture and civil engineering».

Full name	Academic degree/ academic title	Position	Workplace	Signature
<b>Chairperson of Academic Committee:</b>				
Alimova Kulyash	cand. tech. sciences	Head department, associate professor	Department of "Engineering systems and networks" IAC named after T. K. Basenov	
<b>Teaching staff:</b>				
Halkhabay Bostandyk	cand. tech. sciences, docent	Associate Professor	department "Engineering systems and networks"	
Khoyshiev Amirkhan	cand. tech. sciences	Associate Professor	department "Engineering systems and networks"	
<b>Employers:</b>				
Zhumartova Aliya		headmaster	LLP "Research Center Eco Zhobalau"	
<b>Students:</b>				
Shalkar Saken		Master student	1st course	
Bayarystanov Madiyar		Student	4th course	

## **Table of contents**

List of abbreviations and designations	4
1. Description of educational program	5
2. Purpose and objectives of educational program	5
3. Requirements for evaluating the educational program learning outcomes	6
4. Passport of educational program	10
4.1. General information	10
4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines	12
5. Curriculum of educational program	28
6. Additional educational programs (Minor)	31

## **List of abbreviations and designations**

**NJSC KazNRTU named after K.I.Satbayev** - NJSC "Kazakh National Research Technical University named after K.I.Satbayev";

**SOSE** - State obligatory standard of education of the Republic of Kazakhstan;

**EP** - educational program;

**SIS** - student independent study (student, undergraduate, doctoral student);

**TSIS** – independent study of a student with a teacher (independent work of a student (undergraduate, doctoral student) with a teacher);

**WC**- working curriculum;

**CED** - catalog of elective disciplines;

**UC**– university component;

**CC** –component of choice;

**NQF** – national qualifications framework;

**SQF** – sectoral qualifications framework;

**LO** – learning outcomes.

## 1. Description of educational program

Within the framework of the undergraduate specialty, the university independently develops various educational programs in accordance with the National Qualification Framework, professional standards and agreed with the Dublin descriptors and the European Qualification Framework.

Educational programs should be focused on learning outcomes.

Dublin descriptors, which are a description of the level and scope of knowledge, skills, abilities and competencies acquired by students upon completion of the educational program of each level (stage) of higher and postgraduate education, are based on learning outcomes, formed competencies, as well as the total number of credit (credit) units ECTS.

The structure of the educational program of the bachelor's degree is formed from various types of educational and scientific work that determine the content of education, and reflects their correlation, measurement and accounting.

The list of disciplines of the elective component is determined by the university independently. This takes into account the expectations of employers and the needs of the labor market.

Direction of professional activity:

- training of bachelors for the construction and thermal power industries, who are able to design, build and operate civil, industrial and municipal facilities in the field of engineering systems and networks.

Content of professional activity:

- competently make calculations of elements and structures, engineering systems and networks, draw up high-quality technical solutions, develop technical specifications for construction in the design and reconstruction, taking into account the requirements of energy saving, ecology and life safety.

Specific activities are determined by the content of the educational and professional program developed by the university.

## 2. Purpose and objectives of educational program

**Purpose of EP:** Training of highly qualified, competitive specialists in the field of engineering systems and networks: design, installation, reconstruction and operation of engineering systems and structures, namely heating, gas supply, heat supply, ventilation, air conditioning, water supply and sewerage systems. The training ends with the award of the degree "Bachelor of Engineering and Technology".

**Tasks of EP:**

- Studying the cycle of general education disciplines to provide 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;

- The study of the cycle of basic disciplines to provide knowledge of natural sciences, general technical and economic disciplines, as the foundation of vocational education;

- Studying a cycle of major disciplines for the formation of theoretical knowledge, practical skills and abilities in the field of engineering systems and networks;
- The study of disciplines that form knowledge, skills and abilities of planning and organizing research, designing engineering systems and networks, including the use of modern computer technologies and programs;
- Familiarization with potentially dangerous processes and equipment of industrial facilities during the period of production practices;
- Acquisition of skills and abilities of modern control in the field of engineering systems and networks;
- Acquisition of skills to assess working conditions at production facilities for the preparation of regulatory documentation and all types of reporting on their certification.

### **3. Requirements for evaluating the educational program learning outcomes**

Description of mandatory standard requirements for graduation from a university and the award of an academic degree of a bachelor of engineering and technology: mastering at least 240 academic credits of theoretical training and final thesis.

Descriptors of the level and scope of knowledge, skills and competencies

A - knowledge and understanding:

A1 - Demonstrate knowledge and understanding at a professional level;

A2 - Communicate clearly and concisely your findings and knowledge;

A3 - Strive to obtain the most advanced knowledge in the profession.

B – application of knowledge and understanding:

B1 - Independent development and promotion of various options for solving professional problems using theoretical and practical knowledge;

B2 - Apply knowledge to new or unfamiliar situations;

B3 - Ability to solve problems within broader interdisciplinary areas related to professional activity.

C - formation of judgments:

C1 - Collect the necessary information;

C2 - Be able to interpret information to form judgments, taking into account social, ethical and professional scientific considerations;

C3 - Make judgments based on incomplete or partial information.

D - personal abilities:

D1 - Readiness for social mobility;

D2 - Willingness to adapt to new situations, re-evaluate the accumulated experience;

D3 - Ability to learn independently.

Competencies upon completion of training

B - Basic knowledge, skills and abilities:

B1 - Possess basic knowledge in the field of natural sciences (social, humanitarian, economic) disciplines that contribute to the formation of a highly educated personality with a broad-minded culture of thinking;

B2 - have the skills to use information technology in the field of engineering systems of buildings and structures;

B3 - have the skills to acquire new knowledge necessary for professional activities and continuing education in the magistracy.

P - Professional competencies, including in accordance with the requirements of industry professional standards:

P1 - A wide range of theoretical and practical knowledge in the professional field

P 1 Able to logically represent acquired knowledge and understanding of systemic relationships within disciplines, as well as interdisciplinary relationships in modern science.

P 2 Able to build technologies for teaching new knowledge.

P 3 Possession of approaches and methods of critical analysis, the ability to practical use with regard to various shapes and processes of modern society.

P 4 Willingness to work independently, the ability to manage your time, plan and organize activities.

P 5 Willingness for continuous self-development, the ability to build strategies for personal and professional development of training.

P 6 Able to determine the modes of operation of the equipment of engineering systems and networks.

P 7 Able to calculate and select equipment for engineering systems and networks.

P 8 Able to properly and safely operate the equipment of engineering systems and networks.

P 9 Able to independently master new equipment, technological and technical documentation.

P 10 Able to make technical and economic comparisons of various design options for engineering systems and networks.

P 11 Skills in the design of engineering systems and networks.

P 12 Knowledge of the requirements of the Rules of safety, labor protection and environmental protection from the harmful effects of production and the ability to use them in practice.

P 13 Be fluent in professional kazakh, russian and one of the common foreign languages.

P 14 Knowledge of energy and resource-saving technologies and the ability to use them in engineering systems.

P 15 Knowledge of the basics of operation of engineering systems, networks and their equipment.

U - Universal, social and ethical competencies

- U 1 To know the history of the Republic of Kazakhstan, the stages of development of the state and prospects.
- U 2 Ability to use modern information technologies to gain access to information sources.
- U 3 Be proficient in the state, russian and one of the common foreign languages at a level that ensures human communication.
- U 4 Understanding and practical use of the norms of a healthy lifestyle, including prevention issues, the ability to use physical culture to optimize performance.
- U 5 Knowledge and understanding of their rights and obligations as a citizen of the Republic of Kazakhstan.
- U 6 Understanding the values of culture, science and industry.
- U 7 Knowledge and understanding of professional ethical standards, possession of professional communication techniques.
- U 8 Ability to build interpersonal relationships and work in a group (team).
- U 9 Awareness in the field of project management and business, the basics of micro and macroeconomics, knowledge and understanding of risks in a changing environment.
- U 10 Awareness of the need and the acquisition of the ability to independently learn and improve their skills throughout their working life.
- U 11 Ability to use energy and resource saving technologies.
- U 12 Ability to practically use the basics and methods of mathematics, physics and chemistry.
- U 13 To know and master the basics of organizing construction and installation works and the operation of engineering systems and networks.
- U 14 Know and own the main business processes in the enterprise.

#### S - Special and managerial competencies

S1- Independent management and control of the processes of labor and educational activities within the framework of the strategy, policy and goals of the organization, discussion of the problem, argumentation of conclusions and competent handling of information.

- S 1 to have the skills of professional communication and intercultural communication, oratory, the correct and logical formulation of their thoughts in oral and written form.
- S 2 be able to economically justify and solve issues related to the organization of the production process, determine the volume and quality indicators of engineering systems, process and analyze the results of theoretical and experimental studies on the technical level and operational state of engineering systems and structures.
- S 3 possess risk management skills using traditional and modern technologies based on the application of the methodology for building risk representation models in the field of engineering systems, analysis and comparison of risk alternatives; be able to navigate freely in applied work



on the analysis and risk management in supply chains, manage conflicts and know business ethics.

S 4 to be able to competently make independent decisions based on the acquired knowledge for subsequent practical justifications aimed at improving the functioning of the construction industries of engineering systems of buildings and structures.

S 5 to be able to make optimal management decisions in various conditions, to have knowledge of the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

S 6 to possess the skills of acquiring new knowledge, expanding and deepening the knowledge necessary for everyday professional activities and continuing education in doctoral studies, be capable of self-improvement and personal growth.

## 4. Passport of educational program

### 4.1. General information

№	Field name	Comments
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 work and civil engineering
4	Educational program name	6B07306 "Engineering systems and networks"
5	Short description of educational program	<p>Training of specialists in the field of engineering systems and networks, design, installation, reconstruction and operation of engineering systems and structures, namely heating systems, gas supply, heat supply, ventilation, air conditioning, heat generating installations, water supply and sewerage.</p> <p>Students study the methods of design work, gain skills in the operation and installation of heating, ventilation and air conditioning systems, water supply, sewerage, heat supply, gas supply and boiler houses, as well as the reconstruction of these systems.</p> <p>Students learn to make calculations of elements and structures of engineering systems and networks, draw up high-quality technical solutions, develop technical specifications for construction in the design and reconstruction, taking into account the requirements of energy saving, ecology and life safety.</p>
6	Purpose of EP	Training of highly qualified, competitive specialists in the field of engineering systems and networks: design, installation, reconstruction and operation of engineering systems and facilities, namely heating, gas supply, heat supply, ventilation, air conditioning, water supply and sewerage systems. The preparation ends with the awarding of the degree «Bachelor of Engineering and Technology».
7	Type of EP	New
8	The level based on NQF	6
9	The level based on IQF	6
10	Distinctive features of EP	
11	List of competencies of educational program	<p>Knowledge and understanding;</p> <p>Application of knowledge and understanding;</p> <p>Formation of judgments;</p> <p>Personal abilities;</p> <p>Professional competencies;</p> <p>Universal, social and ethical competencies;</p> <p>Special and managerial competencies.</p>
12	Learning outcomes of educational program	<p>LO1 - Possess basic knowledge in the field of natural science disciplines that contribute to the solution of professional problems in the field of engineering systems and the formation of a highly educated personality with a broad outlook.</p> <p>LO2 – Possess the methods and means of physical and mathematical (computer) modeling, including the use of universal and specialized software and computer systems for solving engineering problems in the field of housing and communal services.</p>

		<p>LO3 – Know the development trends and the importance of applied programs in engineering systems, methods of constructing flat projection models of three-dimensional space.</p> <p>LO4 – Possess a regulatory framework in the field of engineering surveys, planning, development and design principles for engineering networks of cities and towns.</p> <p>LO5 – To be able to maintain documentation on quality management and methods of design, construction, installation and reconstruction of engineering networks, to know the requirements of labor protection and the basics of environmental safety in professional activities.</p> <p>LO6 – Know the rules and technologies for installation, adjustment, testing and commissioning of equipment for heating, ventilation, air conditioning, heat and gas supply, water supply and sewerage systems at housing and communal services facilities.</p> <p>LO7 – Own the methods of engineering calculations, apply them to solve specific problems, put them up for discussion and be able to defend the accepted options on specific professional issues.</p> <p>LO8 – To be able to apply a system of fundamental knowledge (mathematical, natural science, engineering and economic) to identify, formulate and solve engineering problems.</p> <p>LO9 – To be able to rationally choose equipment for engineering systems of buildings and structures in accordance with their purpose, taking into account economic requirements and environmental safety.</p> <p>LO10 – Have knowledge of the main elements of external water supply systems, sewerage, heating, gas networks, as well as sources of water, heat, gas and the skills to calculate them.</p> <p>LO11 – Possess knowledge of the regulatory framework in the field of heating, ventilation, water supply, sewerage, as well as design principles taking into account innovative technologies.</p> <p>LO12 – Possess regulatory, economic and organizational knowledge when conducting business in the conditions of the Kazakh economy. Know professional ethics, ethical codes, generally accepted business rules. Know the concept, content and types of corruption.</p> <p>LO13 – To form a systematic knowledge of the basics of the organization, the responsibility of business entities. Possess the norms of international law on corruption. Develop organizational and managerial skills in conducting business.</p>
13	Education form	full-time
14	Period of training	4
15	Amount of credits	240
16	Languages of instruction	kazakh, russian
17	Academic degree awarded	Bachelor of engineering and technology
18	Developer(s) and authors	Alimova K.K., Serikbayeva Zh.S., Orazbayeva A.K.

## 4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)												
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
<b>Cycle of general education disciplines</b>																
<b>Required component</b>																
1	English	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. When moving from level to level, prerequisites and postrequisites of disciplines are observed.	10	✓	✓											
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 covers the specifics of the scientific style in order to develop and activate professional communication skills and abilities of students. The course allows students to practically master the basics of the scientific style and develop the ability to produce a structural and semantic analysis of the text.	10	✓	✓											
3	Physical education	The purpose of the discipline is to master the forms and methods of forming a healthy lifestyle within the framework of the vocational education system. Acquaintance with the natural-science foundations of physical education, possession of modern health-improving technologies, the main methods of independent physical education and sports.	8	✓	✓											
4	Information and Communication technology	The task of studying the discipline is to acquire theoretical knowledge about information processes, new information technologies, local and global computer networks, methods of information protection; obtaining skills in the use of text editors and spreadsheet processors;	5	✓	✓	✓	✓				✓					

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY  
named after K.I.SATBAYEV»

		creation of databases and various categories of application programs.															
5	Modern 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 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 Kazakh statehood are also considered: the era of the Kazakh Khanate of the XV-XVIII centuries. Kazakhstan within the Russian Empire; Kazakhstan in the period of civil confrontation and in the conditions of a totalitarian system; Kazakhstan during the Great Patriotic War; Kazakhstan in the period of formation of independence and at the present stage.	5	v	v	v											
6	Philosophy	Philosophy forms and develops critical and creative thinking, worldview and culture, provides knowledge about the most general and fundamental problems of being and endows them with a methodology for solving various theoretical practical issues. Philosophy expands the horizon of vision of the modern world, forms citizenship and patriotism, contributes to the education of self-esteem, awareness of the value of human existence. It teaches to think and act correctly, develops the skills of practical and cognitive activity, helps to seek and find ways and means of life in harmony with oneself, society, and the world around.	5	v	v	v											
7	Module of socio-political knowledge (sociology, political science)	The purpose of the course: the formation of theoretical knowledge about society as an integral system, its structural elements, connections and relationships between them, the features of their functioning and development, as well as the political socialization of students	3												v	v	v

		of a technical university, ensuring the political aspect of training a highly qualified specialist based on modern world and domestic political thought . The tasks of mastering the discipline: the study of the basic values of social and political culture and the willingness to rely on them in their personal, professional and general cultural development; study and understanding of the laws of development of society and the ability to operate this knowledge in professional activities; the ability to analyze social and political problems, processes, etc.													
8	Module of socio-political knowledge (cultural studies, psychology)	It is designed to acquaint students with the cultural achievements of mankind, to understand and assimilate the basic forms and universal patterns of the formation and development of culture, to develop their desire and skills to independently comprehend the entire 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, leading cultural concepts, universal patterns and mechanisms for the formation and development of culture, the main historical stages of the formation and development of Kazakhstani culture, its most important achievements. In the course of studying the course, students acquire theoretical knowledge, practical skills and abilities, forming their professional orientation from the standpoint of psychological aspects.	5	v										v	v
<b>Cycle of general education disciplines University component</b>															
9	The basics of anti-corruption culture	The discipline "fundamentals of anti-corruption culture" is an important component and is one of the social and humanitarian disciplines. This discipline reveals the General laws of emergence, development and functioning of anti-corruption culture, and organically	5											v	v

		connected with them other social phenomena and processes.																
10	Fundamentals of entrepreneurship and leadership	Students will study the theory and practice of entrepreneurship as a system of economic, organizational and legal relations between business structures. The discipline is aimed at revealing the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of a modern entrepreneur, as well as theoretical and practical business planning and economic examination of business ideas.	5														✓	✓
11	Ecology and life safety	The discipline provides theoretical and practical skills in the field ecology and safety, and is also aimed at forming a conscious and responsible attitude to safety and ecology among students, at acquiring ability to identify hazards, readiness to apply professional knowledge minimize negative production factors, ensure environmental safety and improve working conditions.	5					✓	✓		✓	✓						
<b>Cycle of basic disciplines University component</b>																		
12	Mathematics I	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		✓						✓	✓						
13		The discipline is a continuation of Mathematics 1. The sections of the course include: elements of linear algebra and analytical geometry.	5		✓						✓	✓						

	Mathematics II	Differential calculus of a function of several variables and its applications. Multiple integrals. The objectives of the course are to instill in students solid skills in solving mathematical problems with bringing the solution to a practically acceptable result. To develop primary skills of mathematical research of applied issues and the ability to independently understand the mathematical apparatus contained in the literature related to the student's specialty.													
14	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		✓					✓	✓				
15	Engineering and computer graphics	The course develops the following skills in students: to depict all kinds of combinations of geometric shapes on a plane, to conduct research and their measurements, allowing for image transformations; create technical drawings, which are the main and reliable means of information, providing a link between the designer and the designer, technologist, builder, in AutoCAD.	5		✓	✓					✓				
16	Introduction to the specialty	The purpose of studying the discipline is to stimulate students' interest in the chosen educational program. Obtaining the necessary theoretical knowledge and practical skills in the field of design, construction, operation and reconstruction of engineering systems and	4				✓		✓		✓				



		networks of housing and communal services in cities and towns.														
17	Chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental laws of chemical thermodynamics and kinetics; quantum mechanical theory of atomic structure and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. The structure of matter and the chemistry of elements.	5	✓							✓		✓			
18	Hydro and gas dynamics	"Hydrogasodynamics" is a discipline, which is a general theoretical basis for calculation methods for various hydrosystems and heat engineering devices. Hydrogasodynamics is the science of the motion of a continuous liquid and gaseous medium. Heat and mass transfer together with thermodynamics is the science of the processes of obtaining, converting, using and transferring heat.	6	✓			✓				✓		✓			
19	Engineering mechanics	The discipline studies the conditions of equilibrium of a solid body, methods for specifying the movement of a point, basic concepts and definitions, methods and principles for calculating structural elements for strength and rigidity for the simplest types of deformations, as well as recommendations for the rational design of engineering structures.	5			✓					✓	✓				
20	Building materials	The discipline studies natural and artificial materials and products used in the construction of buildings and structures, the relationship of their composition, structure and properties, classification by origin, purpose, technological features, technological principles of production, in accordance with the nomenclature of their most important groups.	5					✓			✓	✓				
21	Geodesy	To acquaint students with the science that studies the shape and size of the Earth's surface or its individual sections by mathematical	5	✓				✓				✓				

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY  
named after K.I.SATBAYEV»

		measurement with the construction of maps, plans used to solve engineering, cadastral and other tasks. The study is based on methods for determining the geometric proportions, dimensions and location of the most significant objects in relation to each other using modern technology and technology.													
22	Architecture and building structures	The main provisions of the design of buildings and structures are presented, their classification is considered, the main parts and elements, structural systems and schemes, basic information about building structures, including the principles of their design, as well as methods for calculating building structures.	5		✓			✓				✓			
23	BIM technology in engineering systems	BIM technologies in engineering systems (BIM) is the process of collective creation and use of information about an engineering structure, forming the basis of all decisions throughout the life cycle of an object (from planning to design, release of working documentation, construction, operation and demolition). BIM is based on a three-dimensional information model, on the basis of which the work of the investor, the customer, the designer, the contractor and the operating organization is organized.	5		✓	✓					✓				
24	Economics of engineering systems	The discipline studies the issues of economic efficiency of engineering equipment systems, methods of their research. The technical and economic foundations of the design and construction of systems of engineering equipment of cities, the issues of economics of enterprises processing energy resources and providing engineering services are considered.	5								✓	✓		✓	
25	Educational practice	Practice in obtaining primary professional skills. It consists in the practical training of a future specialist and consolidates the theoretical knowledge gained. The purpose of the training practice is to acquire primary professional experience.	2	✓	✓						✓				

<b>Cycle of basic disciplines</b>															
<b>Component of choice</b>															
26	Pumps and fans	The discipline "Pumps and fans" provides general information about pumps, pumping units and fans, as well as their characteristics and classifications, operating parameters, design features. The discipline studies the technological parameters of a centrifugal pump, fans and the construction of their characteristics, water and heat pumping stations.	5						v			v	v		
27	Pumps and pump stations	The discipline "Pumps and pump stations" provides general information about pumps, pumping stations, the working parameters of the joint operation of pumps and water pipelines, the design and operation features of pumping stations, as well as their technological parameters. Studies the types of pumping stations and their designs, water and sewer pumping stations.	5						v			v	v		
28	Heat transfer in fences	The discipline "Heat transfer in fences" studies the process of stationary and non-stationary heat transfer through fences, as well as heat transfer through single-layer and multi-layer fences. Provides general information about the characteristics of thermal inertia and thermal stability of fences, about the receipt of solar radiation through windows and opaque fences, as well as their thermal and humidity conditions.	5							v	v			v	
29	Water quality indicators	The discipline "Water quality indicators" studies the quality indicators of natural and wastewater, as well as the theoretical foundations of natural and wastewater treatment methods – sedimentation, coagulation, sorption and other methods. Provides information about the basics of general microbiology and representatives of the microcosm inhabiting water bodies.	5						v	v			v		
30	Heat and Mass Exchange	The special course is devoted to presentation of phenomena of heat and mass transfer.	5							v	v			v	

		Including: heat exchange mechanisms, differential equation of heat conductivity and methods of its solution, equation system of convective heat exchange equations, application of similarity theory, the theory of boundary layer for the study of problems of convective heat transfer, heat transfer in pipes and natural convection, heat exchange in phase and chemical transformations, and complex heat exchange, mass transfer, concentration and thermal barodiffusion, heat transfer in nanostructures.													
31	Water intake facilities	The discipline "Water intake facilities" gives an idea of the role and importance of the location of water intake structures. Studies types and designs, features of structures for specific conditions, and also considers classification, fundamentals of theory, characteristics, methods of regulation, device and features of operation of various water intake structures. The purpose of teaching the discipline is to form a complex of knowledge and prepare a future specialist in the field of water intake structures, to familiarize with modern equipment and pumps.	5				✓		✓				✓		
32	Gas supply	The discipline "Gas supply" gives an idea about the properties and characteristics of gaseous fuels, methods of gas consumption, about the device and principle of operation of equipment installed on gas networks, about the processes of fuel combustion, designs of gas burners and methods for calculating them.	5				✓		✓				✓		
33	Sewer networks	The discipline "Sewer networks" studies the issues of wastewater disposal from settlements, systems and schemes of sewer networks, as well as structures on networks; hydraulic calculation of sewer networks, determination of estimated wastewater costs and pipe diameters.	5				✓		✓				✓	✓	
34	Heat-generating installations	Discipline "Heat-generating plants" gives an idea of the properties and characteristics of	5						✓		✓	✓			

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY  
named after K.I.SATBAYEV»

		energy fuels, their combustion processes, methods of burning fuels, the device and the principle of operation of the main and auxiliary equipment of heat generating plants.														
35	Integrated use of water	The discipline "Integrated use of water" is an integrated discipline and has as its main goal the formation of students' systematic knowledge of solving complex water management problems.	5				✓	✓							✓	
36	Heat supply	The discipline "Heat supply" provides basic theoretical knowledge and the basic provisions of the design and installation of heat supply systems. Studies the basics of calculating heat release by types of heat consumption.	6			✓	✓			✓		✓				
37	Water supply systems	The purpose of studying the discipline "Water supply systems" is to acquire students' theoretical knowledge and practical skills in the basics of design, calculation and operation of natural water transportation. "Water supply networks" gives an idea of the theoretical foundations of water supply networks, as well as the basics of designing and calculating the water supply network. Devices of natural water transportation systems.	6			✓	✓		✓					✓		
38	Fundamentals of scientific research in water management	The purpose of teaching the discipline "Fundamentals of scientific research in water management" is to acquire skills on issues of water zoning, drawing up water balances, identifying and preventing the negative impact of human activities on water resources using the results of scientific research.	4	✓							✓				✓	
39	Purification of gaseous emissions	The discipline "Purification of gaseous emissions" studies the structure of the atmosphere, the peculiarities of meteorological processes occurring in it, quality criteria (purity) atmospheric air, the impact on the environment of emissions of pollutants, methods for calculating their amount, factors determining the conditions for effective dispersion of	4					✓		✓		✓				

		harmful emissions in the atmosphere and modern methods of gas purification.														
40	Alternative heat sources	The purpose of teaching the discipline is to acquire students' theoretical knowledge and practical skills on the basics of designing, installing and operating alternative heat sources. They will study the basics of designing autonomous heat supply systems; the methodology of hydraulic calculation of quarterly heating networks; the equipment used and their designs.	5			v	v					v	v	v		
41	Use of water energy	The discipline "Use of water energy" considers the conditions and schemes for the use of water resources, the characteristics of water resources. Provides a quantitative assessment of the energy of water resources, the main ways of using water energy by hydroelectric power plants. Studies the initial data for water management and water-energy calculations, forecasting, calculations and regulation of the flow of water sources. Examines the characteristics of reservoirs and the construction of integral flow curves, methods of water-power calculations, equipment of hydroelectric power plants, turbine installations, the composition of structures and layout of hydroelectric power plants.	5				v					v	v			
42	Energy-saving technologies in the heat and ventilation systems	The discipline studies the classification of energy resources, the general principles of resource saving, heat energy calculations. Measures to save in heat generating installations, methods and means of energy saving in heat and gas supply and ventilation systems.	5			v							v	v		
43	Resource-saving technologies in water supply and sewerage systems	Resource-saving technologies in water supply and sewerage systems studies methods and means of water saving in industry and public utilities. Classification of methods of water conservation, waste water recycling for reuse in	5				v						v	v		

		industry and in agriculture. Economic aspects of water conservation application.													
<b>Cycle of profile disciplines</b>															
<b>University component</b>															
44	Sanitary and technical devices of the building	The discipline "Sanitary devices of buildings" gives an idea of the sanitary and technical devices of buildings. Sanitary-technical devices of buildings include cold and hot water supply systems, sewerage. The purpose of sanitary and technical devices of buildings is to provide water for household needs and production processes, wastewater disposal, solid and liquid emissions.	5		✓							✓		✓	
45	Technology of installation and construction works	The discipline studies the theoretical foundations, modern methods and methods of performing construction and installation processes of heat and gas supply and ventilation systems, including procurement, welding, based on the use of effective labor organization, modern technical means, structures and materials.	5					✓	✓					✓	
46	Production practice I	The purpose of the internship is to consolidate and expand the theoretical knowledge gained by students in the process of studying disciplines. Provides consolidation of knowledge, skills of theoretical training and is an intermediate link between the studied disciplines and production.	2		✓		✓	✓	✓						
47	Production practice II	The purpose of the internship is to consolidate and expand the theoretical knowledge gained by students in the process of studying the disciplines of the profile cycle, as well as to familiarize students with occupational safety issues, with the methods of production of certain types of work on the construction of engineering systems of buildings and structures.	3		✓		✓	✓	✓						
<b>Cycle of profile disciplines</b>															
<b>Component of choice</b>															
48	Comfort of the room	The discipline "Comfort of the room" provides a systematic presentation of the provisions that	4								✓	✓		✓	

		represent the theoretical basis for studying the technology of providing a microclimate, the acquisition by students of theoretical knowledge and practical skills necessary to understand the processes and phenomena associated with the consideration of the thermophysical foundations of the transfer of heat, moisture through the building envelopes of the air regime of the building, regulation of thermal regime using modern concepts of the theory of heat and mass transfer.														
49	Water resources management	The main objectives of the discipline “Water resources management” include issues of water use, water consumption and the protection of water resources in water basins, the study of methods for analyzing water consumption and water disposal, factors and patterns of water consumption and water disposal in industries in cities and towns.	4				✓	✓	✓		✓					
50	Heat and gas networks	The discipline "Heat and gas networks" studies the types and characteristics of thermal and gas installations. Hydraulic calculations of thermal and gas systems, selection of basic equipment are carried out. Boiler installations, gas distribution stations and their principle of operation are envisaged.	5			✓	✓			✓			✓			
51	Industrial water supply and sewerage	The purpose of teaching the discipline "Industrial water supply and sewerage" is the acquisition by students of theoretical knowledge and practical skills in water treatment and sanitation of industrial enterprises, the study of schemes and methods of water treatment of softening, desalination, degassing, ion exchange and other methods. Disposal of industrial effluents and sediments.	5			✓	✓		✓				✓			
52	Water treatment in boiler and heating networks	The discipline "Water treatment in boiler and heating networks" gives an idea of the processes occurring in the water circulating in heat generating plants and heat networks, as well as the processes and phenomena occurring in water	4						✓		✓	✓				



		treatment plants during the processing of feed water of steam boilers and make-up water of heat networks.														
53	Water supply and sewerage special systems	The discipline "Water supply and sewerage special systems" studies general information about special water supply and sanitation systems, methods of desalination and desalination of water, methods of water softening, methods of natural water degassing, drainage systems of sparsely populated areas, local wastewater treatment and individual treatment facilities.	4			✓	✓		✓				✓			
54	Ventilation and air conditioning	The discipline "Ventilation and air conditioning" reflects the current state of the theory and practice of applied aerodynamics and thermophysics in ventilation and air conditioning. It outlines the basics of calculating the design, commissioning and operation of ventilation and air conditioning systems in buildings and structures. The fundamentals of aerodynamics of ventilation systems in buildings and structures are considered.	6		✓				✓					✓		
55	Technology of natural water treatment	The discipline "Technology of natural water treatment" provides basic information about methods and schemes of natural water purification; types and designs of the main facilities for natural water purification; the basics of calculating facilities for natural water purification; as well as the main methods and facilities for the preparation of drinking water, requirements for the quality of drinking water, the choice of the method of purification and schemes of treatment plants.	6					✓		✓			✓			
56	Heating	The discipline "Heating" reflects the current state of the theory and practice of the heating system; it outlines the basics of calculating the design, commissioning and operation of the system in residential, public and industrial buildings. The issues devoted to the	6		✓	✓			✓			✓		✓		

		improvement and development of heating systems, the use of renewable energy sources, saving thermal energy for heating buildings are considered.														
57	Wastewater treatment technology	The discipline "Wastewater treatment technology" provides basic information about methods and schemes of wastewater treatment; types and designs of the main wastewater treatment facilities; fundamentals of calculation of wastewater treatment facilities; basic methods and facilities for the treatment of precipitation. Determination of the required degree of wastewater treatment, selection of the treatment method and the scheme of the treatment plant.	6					✓		✓			✓			
58	Systems of hot water supply of buildings	The discipline "Systems of hot water supply of buildings" provides basic theoretical knowledge and the basic provisions of the design and installation of hot water systems.	5		✓							✓		✓		
59	Disposal of wastewater and sludge	The discipline "Disposal of wastewater and sludge" considers technological schemes for treating sewage sludge from various industrial enterprises, designing, calculating sewage treatment facilities, and using sludge in agriculture.	5							✓	✓		✓			
60	Occupational safety during the operation of engineering networks and structures	The discipline studies the structure of engineering networks of cities and towns. Types and characteristics of pumping stations in engineering networks. Introduces regulatory materials for the safe operation of external engineering networks.	5	✓				✓				✓	✓			
61	Rational water use	During the course, the student will master the basics and methods of rational and efficient use of water, methods for calculating the required parameters and planning water use in the water supply system, in agriculture and in industry.	5				✓						✓	✓		
62	Autonomous heat supply systems	The discipline "Autonomous heat supply systems" studies the basics of heat supply of buildings and structures. Types and	5			✓			✓		✓					

		characteristics of heating devices, pumps, boiler installations and hydraulic calculation of heat supply systems.														
63	Local water supply and sewerage systems	The discipline "Local water supply and sewerage systems" studies the issues of water supply and sewerage of enterprises, hydraulic calculation of water supply and drainage networks, determination of the estimated costs of process water and pipeline diameters.	5			✓	✓		✓				✓			
64	Ventilation of industrial buildings and structures	The discipline "Ventilation of industrial buildings and structures" reflects the current state of the theory and practice of applied aerodynamics and thermal physics in ventilation; it outlines the basics of calculating the design, adjustment and operation of ventilation systems in buildings. The properties of air and the processes of changing its state, air exchange and organization of air distribution in the room, local exhaust and supply ventilation, design devices and operation of ventilation systems are considered.	5		✓				✓			✓				
65	Closed water supply systems	The discipline "Closed water supply systems" provides theoretical knowledge and practical skills on the circulating water supply of industrial enterprises, studies special methods of water treatment for technological purposes, as well as the disposal and purification of industrial wastewater for return to the circulating water supply.	5			✓	✓		✓				✓			

## 5. Curriculum of educational program



MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN  
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATBAYEV



CURRICULUM  
of Educational Program on enrollment for 2022-2023 academic year

Educational program 6B07306 – "Engineering systems and networks"  
Group of educational programs B074 – "Urban planning, construction works and civil engineering"

Discipline code	Name of disciplines	Cycle	Duration of study: 4 years				SIS (including TSIS) in hours	Form of control	Academic degree: Bachelor of engineering and technology														
			Total amount in credits	Total hours	Classroom amount lec/lab/pr	Allocation of face-to-face training based on 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								
<b>CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)</b>																							
<b>M-1. Module of language training</b>																							
LNG 108	English language	GED, RC	10	300	0/0/6	210	E	5	5														
LNG 104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5														
<b>M-2. Module of physical training</b>																							
KFK101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Discredit	2	2	2	2												
<b>M-3. Module of information technology</b>																							
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5												
<b>M-4. Module of socio-cultural development</b>																							
HUM 100	Modern 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)		5	150	2/0/1	150	E			5													
<b>M-5. Module of anti-corruption culture, ecology and life safety base</b>																							
HUM 133	Fundamentals of anti-corruption culture	GED, CCH	5	150	2/0/1	150	E				5												
MNG 488	Fundamentals of Entrepreneurship and Leadership																						
HYD 438	Ecology and life safety																						
<b>CYCLE OF BASIC DISCIPLINES (BD)</b>																							
<b>M-6. Module of physical and mathematical training</b>																							
MAT 101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5															
PHY 468	Physics	BD, UC	5	150	1/1/1	105	E	5															
MAT 102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5														
<b>M-7. Module of basic training</b>																							
GEN 429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E	5															
HYD450	Introduction to the specialty	BD, UC	4	120	2/0/1	75	E	4															
CHE495	Chemistry	BD, UC	5	150	1/1/1	105	E		5														
HYD119	Hydro and gas dynamics	BD, UC	6	180	2/1/1	120	E			6													
CIV708	Engineering mechanics	BD, UC	5	150	1/0/2	105	E				5												
CIV956	Building materials	BD, UC	5	150	1/1/1	105	E				5												
MAP160	Geodesy	BD, UC	5	150	1/2/0	105	E				5												
2201	Elective	BD, CCH	5	150	1/1/1	105	E				5												
CIV591	Architecture and building structures	BD, UC	5	150	1/0/2	105	E					5											
2202	Elective	BD, CCH	5	150	1/1/1	105	E					5											
3203	Elective	BD, CCH	5	150	1/0/2	105	E						5										
AAP184	Educational practice	BD, UC	2							2													
<b>M-8. Module of engineering network design</b>																							
HYD449	BIM technology in engineering systems	BD, UC	5	150	1/0/2	105	E						5										
3204	Elective	BD, CCH	5	150	1/0/2	105	E						5										
3206	Elective	BD, CCH	5	150		105	E						5										
4209	Elective	BD, CCH	6	180	2/1/1	120	E												6				
HYD167	Economics of engineering systems	BD, UC	5	150	2/0/1	105	E												5				
<b>M-9. Module "R&amp;D"</b>																							
3205	Elective	BD, CCH	4	120	2/0/1	75	E							4									
3207	Elective	BD, CCH	5	150	1/0/2	105	E												5				
3208	Elective	BD, CCH	5	150	2/0/1	105	E												5				

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY  
named after K.I.SATBAYEV»

CYCLE OF PROFILE DISCIPLINES (PD)																	
<b>M-10. Module of professional activity</b>																	
HYD188	Sanitary and technical devices of the building	PD, UC	5	150	1/0/2	105	E					5					
CIV955	Technology of installation and construction works	PD, UC	5	150	2/0/1	105	E					5					
3301	Elective	PD, UC	4	120	2/1/0*	75	E				4						
<b>M-11. Module of engineering systems design</b>																	
3302	Elective	PD, CCH	5	150	2/1/0*	105	E					5					
3303	Elective	PD, CCH	4	120	2/1/0*	75	E				4						
4304	Elective	PD, CCH	6	180	2/1/1	120	E					6					
4305	Elective	PD, CCH	6	180	2/1/1	120	E					6					
4306	Elective	PD, CCH	5	150	1/0/2	105	E					5					
<b>M-12. Module of technology</b>																	
4307	Elective	PD, CCH	5	150	2/1/0*	105	E					5					
4308	Elective	PD, CCH	5	150	2/1/0*	105	E					5					
4309	Elective	PD, CCH	5	150	2/1/0*	105	E					5					
AAP192	Production practice I	PD, UC	2							2							
AAP193	Production practice II	PD, UC	3								3						
<b>M-13. Module of final attestation</b>																	
ECA003	Preparation and writing of a thesis (project)	FA	6									6					
ECA105	Defense of the thesis (project)	FA	6									6					
<b>M-14. Module of additional types of training</b>																	
AAP500	Military affairs	ATT	0														
<b>Total based on UNIVERSITY:</b>										31	29	28	32	29	31	33	27
										60		60		60		60	

Number of credits for the entire period of study						
Cycle code	Cycles of disciplines	Credits				Total
		required component (RC)	university component	component of choice (CCH)		
GED	Cycle of general education disciplines	51	5			56
BD	Cycle of basic disciplines		67	45		112
PD	Cycle of profile disciplines		15	45		60
	<b>Total for theoretical training:</b>	<b>51</b>	<b>87</b>	<b>90</b>		<b>228</b>
FA	final attestation		12			12
	<b>TOTAL:</b>	<b>63</b>	<b>87</b>	<b>90</b>		<b>240</b>

Decision of the Academic Council of KazNRTU named after K.Satbayev. Protocol № 19, 22.04.2022

Decision of the Educational and Methodological Council of KazNRTU named after K.Satbayev. Protocol № 7, 26.04.2022

Decision of the Academic Council of the Institute of A&C. Protocol № 5, 22.04.2022

Vice-Rector for Academic Affairs

Dean of the Institute of A&C

Head of the department  
"Engineering systems and networks"

Representative of the Council of Employers  
Head of "Ecojobalau" LLP

B. Zhautikov

B. Kuspangaliev

K. Alimova

A. Zhumartova

**NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY  
named after K.I.SATBAYEV»**

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN  
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATBAYEV



Director of the Institute of A&C  
**B. Kuspangaliev B.**  
2022 y.

**ELECTIVE DISCIPLINES for 2022-2023 academic year admission**  
CURRICULUM OF THE EDUCATIONAL PROGRAM for 2022-2023 academic year admission  
Educational program 6B07306 - "Engineering systems and networks"  
Group of Educational programs B074 - "Urban planning, construction works and civil engineering"

Form of study: full-time      Duration of study: 4 years      Academic degree: Bachelor of engineering and technology

Elective code	Discipline Code	Name of discipline	Semester of study	Cycle	Total Credits	Total hours	classroom volume hс/ab/yr	SIS (including SIS) in hours	Form of control	prerequisite
<b>M-7. Module of basic training</b>										
2201	HYD404	Pumps and fans	4	BD, CCH	5	150	1/1/1	105	E	
	HYD405	Pumps and pump stations								
2202	HYD192	Heat transfer in fences	4	BD, CCH	5	150	1/1/1	105	E	
	HYD191	Water quality indicators								
3203	HYD401	Heat and Mass Exchange	5	BD, CCH	5	150	2/0/1	105	E	
	HYD407	Water intake facilities					1/0/2			
<b>M-8. Module of engineering network design</b>										
3204	HYD410	Gas supply	5	BD, CCH	5	150	1/0/2	105	E	
	HYD411	Sewer networks								
3206	HYD406	Heat-generating installations	5	BD, CCH	5	150	1/0/2	105	E	
	HYD434	Integrated use of water					2/0/1			
4209	HYD452	Heat supply	7	BD, CCH	6	180	2/1/1	120	E	
	HYD454	Water supply systems								
Total					31					
<b>M-10. Module of professional activity</b>										
3301	HYD457	Comfort of the room	6	PD, CCH	4	120	2/1/0	75	E	
	HYD458	Water resources management								
<b>M-11. Module of engineering systems design</b>										
3302	HYD421	Heat and gas networks	6	PD, CCH	5	150	1/0/2	105	E	
	HYD423	Industrial water supply and sewerage								
3303	HYD459	Water treatment in boiler and heating networks	6	PD, CCH	4	120	1/0/2	75	E	
	HYD460	Water supply and sewerage special systems								
4304	HYD455	Ventilation and air conditioning	7	PD, CCH	6	180	2/1/1	120	E	
	HYD456	Technology of natural water treatment								
4305	HYD461	Heating	7	PD, CCH	6	180	2/1/1	120	E	
	HYD462	Wastewater treatment technology								
4306	HYD428	Systems of hot water supply of buildings	7	PD, CCH	5	150	1/0/2	105	E	
	HYD429	Disposal of wastewater and sludge								
<b>M-12. Module of technology</b>										
4307	HYD477	Occupational safety during the operation of engineering networks and structures	8	PD, CCH	5	150	1/1/1	105	E	
	HYD431	Rational water use					1/0/2			
4308	HYD426	Autonomous heat supply systems	8	PD, CCH	5	150	1/0/2	105	E	
	HYD427	Local water supply and sewerage systems								
4309	HYD432	Ventilation of industrial buildings and structures	8	PD, CCH	5	150	1/0/2	105	E	
	HYD433	Closed water supply systems								
Total					45					
<b>M-9. Module "R&amp;D"</b>										
3205	HYD451	Fundamentals of scientific research in water management	5	BD, CCH	4	120	2/0/1	75	E	
	HYD453	Purification of gaseous emissions								
3207	HYD412	Alternative heat sources	6	BD, CCH	5	150	1/0/2	105	E	
	HYD413	Use of water energy								
3208	HYD416	Energy-saving technologies in the heat and ventilation systems	6	BD, CCH	5	150	2/0/1	105	E	
	HYD417	Resource-saving technologies in water supply and sewerage systems								
Total					14					
TOTAL					90					

	Credits
The number of credits in elective disciplines for the entire period of study	0-118
Cycle of disciplines	
Cycle of general education disciplines (G)	0
Cycle of basic disciplines (B)	45
Cycle of profile disciplines (P)	45
TOTAL:	90

Decision of the Academic Council of the Institute of A&C № 5 dated "28" 07 2022 y.

Head of the department "Engineering systems and networks"

**K. Alimova**

Representative of the Specialty Council from employers

**A. Zhumartova**

Head of "Ecojobalau" LLP

### 6. Additional educational programs (Minor)

<b>Name of additional educational programs (Minor) with disciplines</b>	<b>Total number of credits</b>	<b>Recommended semesters of study</b>	<b>Documents on the results of mastering the additional educational programs (Minor)</b>
Design, installation and operation of internal engineering systems of buildings and structures	20	5,6,7,8	Certificate