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 name of educational program

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 2025

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

Minutes №10 dated «06» 03 2025.

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

Minutes №3 dated «20» 12 2024.

Educational program 6B07306 "Engineering systems and networks" was developed
code and name of educational program
by Academic committee based on direction 6B073 «Architecture and civil engineering».

Full name	Academic degree/ academic title	Position	Workplace	Signature
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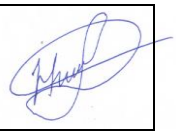
Nurzhigit Kazybek		Master's student	2nd course, EP ESaN	

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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 educational program, 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: The purpose of the educational program is to prepare graduates as a competitive specialist for the construction industry, possessing critical thinking, able to use theoretical and practical information for the design, construction, operation and reconstruction of engineering systems and networks using innovative technologies to form personal, professional qualities and develop creative potential.

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	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. 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. 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.
6	Purpose of EP	The purpose of the educational program is to prepare graduates as a competitive specialist for the construction industry, possessing critical thinking, able to use theoretical and practical information for the design, construction, operation and reconstruction of engineering systems and networks using innovative technologies to form personal, professional qualities and develop creative potential.
7	Type of EP	New
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 program	Knowledge and understanding; Application of knowledge and understanding; Formation of judgments; Personal abilities; Professional competencies; Universal, social and ethical competencies; Special and managerial competencies.
12	Learning outcomes of educational program	LO1 - Possess regulatory, economic, organizational and managerial knowledge in conducting business activities. To

		know professional ethics, ethical codes, the concept, content, types of corruption and generally accepted rules of business. LO2 – Know the main stages of development of housing and communal infrastructure to create comfortable living conditions for the population. LO3 – Possess the regulatory framework for the design of engineering networks of cities and towns, taking into account their layout and development. LO4 – Know the rules of design, installation technology, commissioning, testing and commissioning of equipment for internal engineering systems at housing and communal services and industrial enterprises. LO5 – Possess knowledge on the main types of sources of water, heat, gas and skills in calculating the external elements of engineering networks, taking into account the modern needs of the labor market. LO6 – To master the norms of the international standard for the design and operation of engineering systems and networks, to form systematic knowledge on the organization of business activities and international cooperation involving investment funds in infrastructure and innovation. LO7 – Be able to rationally select modern equipment and devices of engineering systems of buildings and structures in accordance with their purpose, taking into account economic requirements, environmental safety and labor protection. LO8 – Possess basic knowledge in the field of natural sciences that contribute to solving professional problems in the field of engineering systems and networks, explain the basics of philosophical knowledge for the formation of deep worldview positions. LO9 – Apply the fundamentals of mathematical knowledge in engineering systems to solve applied problems using computer modeling in the design and modernization of construction projects. LO10 – Demonstrate a wide range of theoretical and practical knowledge in professional activities, the ability to develop, implement and control the quality and completeness of completed projects. LO11 – To master the techniques of professional communication, the 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 lives. LO12 – o develop the ability to communicate orally and in writing in the state, Russian and foreign languages to solve problems of interpersonal and intercultural interaction. LO13 – Possess knowledge of the selection of water supply sources, water purification technology for populated areas, and perform a technical and economic comparison of adopted engineering solutions.

		LO14 – Possess resource-saving and innovative technologies in engineering systems for housing and communal services, industry and water management complexes. LO15 – Know the processes of water resources management, their effective use in all sectors of the economy, issues of ensuring sustainable abstraction, supply of fresh water, protection and restoration of ecosystems related to water.
13	Education form	full-time
14	Period of training	4
15	Amount of credits	240
16	Languages of instruction	Kazakh, russian, english
17	Academic degree awarded	Bachelor of engineering and technology
18	Developers and authors	Alimova K.K., Berdikul N.I., Aliyakbarova U.H.

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)														
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11	LO12	LO13	LO14	LO15
Cycle of general education disciplines University component																		
1	Fundamentals of anti-corruption culture and law	Purpose: 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. Contents: 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						v			
2	Basics of Financial Literacy	Purpose: formation of financial literacy of students on the basis of building a direct link between the acquired knowledge and their practical application. Contents: 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						v			v		v				
3	Fundamentals of economics and	Purpose: To develop basic knowledge of economic processes	5						v			v			v			v

	entrepreneurship	and skills in entrepreneurial activities. Content: 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, developing business plans, risk assessment, and strategic decision-making.																
4	Fundamentals of scientific research methods	Purpose: The goal of studying the discipline is to develop students' research skills; to introduce students to scientific knowledge, their readiness and ability to conduct research. Objectives of studying the discipline: to contribute to the deepening and consolidation of existing theoretical knowledge by students; to develop practical skills in conducting scientific research, analyzing the results obtained and developing recommendations; to improve methodological skills in independent work with information sources and appropriate software and hardware.	**5**	**v**							**v**		**v**					
5	Ecology and life safety	Purpose: formation of ecological knowledge and consciousness, obtaining theoretical and practical knowledge on modern methods of rational use of natural resources and environmental protection. Contents: 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	**5**		**v**					**v**								

		natural and man-made nature.																	
Cycle of basic disciplines University component																			
6	Mathematics I	Purpose: to introduce students to the fundamental concepts of linear algebra, analytical geometry and mathematical analysis. To form the ability to solve typical and applied problems of the discipline. Contents_ Elements of linear algebra, vector algebra and analytical geometry. Introduction to the analysis. Differential calculus of a function of one variable. The study of functions using derivatives. Functions of several variables. Partial derivatives. The extremum of a function of two variables.	**5**									**v**	**v**					
7	Mathematics II	Purpose: To teach students integration methods. To teach you how to choose the right method for finding the primitive. To teach how to apply a certain integral to solve practical problems. Contents_ integral calculus of the function of one and two variables, series theory. Indefinite integrals, methods of their calculation. Certain integrals and applications of certain integrals. Improper integrals. Theory of numerical and functional series, Taylor and Maclaurin series, application of series to approximate calculations.	**5**									**v**	**v**					
8	Physics	Purpose:To form ideas about the modern physical picture of the world and scientific worldview, the ability to use knowledge of fundamental laws, theories of classical and modern physics. Contents_ physical fundamentals of mechanics,	**5**					**v**				**v**							

		fundamentals of molecular physics and thermodynamics, electricity and magnetism, vibrations and waves, optics and fundamentals of quantum physics.																
9	Engineering and computer graphics	Purpose: To develop students' knowledge of drawing construction and skills in developing graphical and textual design documentation in accordance with standards. Content: 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**					
10	Introduction to the specialty	Purpose: to stimulate students' interest in the chosen educational program and to develop skills in the intended design and operation of engineering systems. Content: obtaining the necessary theoretical knowledge and practical skills in the field of design, construction, operation and reconstruction of engineering systems and networks of housing and communal services in cities and towns.	**4**		**v**			**v**										
11	Hydro and gas dynamics	Purpose: to form knowledge about the laws of fluid motion, the forms of fluid motion and their physical essence, the application of the laws of fluid motion to the calculation of the size of culverts and to the regulation of flows and channel processes at intersections with watercourses. Content: the discipline covers the	**6**					**v**				**v**						

		basics of the laws of hydrogas dynamics for solving engineering problems and patterns of motion of liquids and gaseous media.																
12	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**									**v**	**v**					
13	Building materials	Discipline studies the relationship of composition, structure and properties of materials. Classification of building materials and products, construction materials and materials for special purposes. Technological principles of production, functional, operational properties, areas of application of building materials in accordance with the nomenclature of their most important groups.	**5**					**v**	**v**									
14	Geodesy	To acquaint students with the science that studies the shape and size of the Earth's surface or its individual sections by mathematical 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.	**5**			**v**						**v**						
15	Architecture and building structures	The discipline studies the basic provisions of the design of buildings	**5**			**v**					**v**				**v**			

		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 methods for calculating building structures. The main provisions of the calculation of structures for limiting states.																
16	BIM technology in engineering systems	Purpose: to master all the programs used in the full operation of each construction project, to be able to use them in design, construction and operation. Contents: Design of engineering systems using computer programs. Analysis of the results of the work of engineering systems, their modernization in connection with changes in the operating conditions of the systems, as well as the shortcomings of design solutions. Modernization (reconstruction) is the most effective way to strengthen the system, since it requires less work than new construction.	**5**			**v**	**v**					**v**		**v**				
17	Economics of engineering systems	Purpose: to teach how to use the current legislative and costing and regulatory framework for pricing and costing in the Republic of Kazakhstan; carry out calculations of the estimated cost of construction and certain types of work on the reconstruction and operation of engineering systems and structures. Contents: studies the issues of economic efficiency of engineering equipment systems, methods of their research. The technical and economic fundamentals of the design and construction of engineering systems	**5**							**v**		**v**				**v**		

		and public utility structures in populated areas are considered.																	
18	Computer programs for designing engineering systems	An important objective of sustainable development is the effective design of utility networks using various computer programs. To study innovative design methods using computer programs. Contents: Basic principles of operation of computer-aided design systems. Introduces students to the basics of automated preparation of the graphic part of design documents in the AutoCAD environment. Graphic primitives and their modification. Working with text, blocks, layers. Three-dimensional surfaces and bodies. Basics of constructing drawings in an engineering system using AutoCAD programs. Construction of orthogonal and axonometric projections in the CAD design system. Projections with numerical marks, construction of earthwork boundaries in the AutoCAD system. Construction of axonometric projections using various methods ("extrusion", "rotation") in the AutoCAD system.	**5**			v	v					v	v					
19	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**	v	v						v								
Cycle of basic disciplines Component of choice																			
20	Pumps and fans	Goal: to develop basic knowledge about the design and operating principles of pumps and fans,	**5**				v					v					v		

		methods for their selection and operation, as well as the features of the effective use of blowers in heating, heat supply and ventilation systems. Contents: provides general information about pumps, pumping units and fans, as well as their characteristics and classifications, operating parameters, and design features. The discipline studies the technological parameters of a centrifugal pump, fans and the construction of their technical characteristics.																
21	Pumps and pump stations	Purpose: to develop basic knowledge about the design and operating principles of pumps and pumping stations, methods for selecting pumps and their operation. Contents: provides general information about pumps, pumping stations, operating parameters of the joint operation of pumps and water pipelines, design features and operation of pumping stations, as well as their technological parameters. They study the types of pumping stations and their designs, and also consider water supply and sewage pumping stations.	**5**				**v**					**v**				**v**	**v**	
22	Fundamentals of Artificial Intelligence	Purpose: to familiarize students with the basic concepts, methods and technologies in the field of artificial intelligence: machine learning, computer vision, natural language processing, etc. Contents: general definition of artificial intelligence, intelligent agents, information retrieval and state space exploration, logical agents, architecture of artificial intelligence systems, expert systems, observational learning,	**5**									**v**			**v**			

		statistical learning methods, probabilistic processing of linguistic information, semantic models, natural language processing systems.																	
23	Fundamentals of sustainable development and ESG projects in Kazakhstan	Purpose: 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. Contents: introduces the principles of sustainable development and the implementation of ESG practices in Kazakhstan, includes the study of national and international standards, analysis of successful ESG projects and strategies for their implementation in enterprises and organizations.	**5**						**v**						**v**			**v**
24	Legal regulation of intellectual property	Purpose: 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. Content: 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**	**v**										**v**	**v**			
25	Heat transfer in fences	Purpose: to develop a set of knowledge and skills on methods for calculating the enclosing structures of buildings and structures and applying them in practical work in	**5**		**v**					**v**								

		solving energy saving issues. Content: general information about the characteristics of thermal inertia and thermal stability of fences, the entry of solar radiation through windows and opaque fences, as well as modern methods and problem solving for the selection of heat-protective enclosing structures of buildings for various purposes, reducing humidity in fences and increasing the heat transfer resistance of building elements.																	
26	Water quality indicators	Purpose: Master theoretical and practical knowledge about the physical and chemical properties of water and water systems, the basics of microbiology, study indicators that standardize the quality of natural, drinking and waste water. Contents: Water as a chemical compound. Physical properties of water. Aqueous solutions. Impurities in a dissolved state. Fundamentals of microbiology. General ideas about microorganisms and their morphology. Physiology of microorganisms. The concept of biological wastewater treatment.	**5**					**v**								**v**		
27	Heat and Mass Exchange	Purpose: to study basic information about the thermal behavior of buildings, the properties of thermal radiation of surfaces, radiant heat transfer and heat and mass transfer between room surfaces, general requirements for structures, and improving the quality of the humidity conditions of the external enclosure. Contents: determination of the properties of thermal radiation, radiant heat exchange between room	**5**		**v**						**v**								

		surfaces, types and properties, general requirements for structures and assessment of their technical and economic efficiency using modern scientific, technical and reference literature, determination of their characteristics.																
28	Water intake facilities	Purpose: students acquire theoretical knowledge and practical skills in the design and construction of water intake structures and pumping stations. Contents: forms knowledge about the role and location of water intake structures for supplying surface or groundwater to the population, the type and designs of water intake structures, the features of structures for specific conditions, as well as acquiring skills in their design while meeting the requirements for reliable water supply.	**5**			**v**		**v**						**v**		**v**		
29	Gas supply	Purpose: students' acquisition of theoretical knowledge and practical skills in the design, basics of design and operation of gas supply systems. Content: an understanding of the properties and characteristics of gaseous fuels, methods of gas consumption, the design and operating principle of equipment installed on gas networks, fuel combustion processes, gas burner designs and methods of their calculation.	**5**			**v**		**v**					**v**					
30	Sewer networks	Purpose: to familiarize with the basic equipment in the design and operation of engineering systems for wastewater transportation, to form knowledge about the theoretical justification and practical application	**5**					**v**						**v**		**v**		

		Contents: types of wastewater formation, determination of wastewater consumption, conducting and designing hydraulic calculations of drainage networks, designing linear structures of the network, the student independently uses normative and technical literature.																
31	Heat-generating installations	Purpose: to familiarize with the properties and characteristics of energy fuels, their combustion processes, methods of burning fuels, the design and operating principle of the main and auxiliary equipment of heat-generating installations. Contents: familiarization with the properties, characteristics of fuel, combustion processes, design and operation of main and additional equipment, as well as consumers with heat production processes, economical use of energy resources and the current development of heat production facilities in theory and practice.	**5**			**v**	**v**			**v**								
32	Water supply systems	Purpose: get acquainted with the main equipment in the design and operation of engineering water supply systems, create a theoretical basis and the basis for their design, modern methods of transporting water. Contents: Creation of the basic laws of the water transport system, operating principles and basic calculations, as well as the selection of the main equipment of the water transport system and the use of their modern scientific, technical and reference literature, assessment of their technical and economic efficiency. by determining the	**6**			**v**		**v**									**v**	

		technical characteristics of buildings and systems.																
33	Fundamentals of scientific research in water management	Goal: to develop the student's knowledge, skills and abilities to carry out independent scientific research in the field of engineering and technology of the water management complex, planning and conducting experiments. Contents: studying the fundamentals of methodology, methods and techniques of scientific research; mastering methods for choosing the direction of research work; mastering methods of working with scientific literature and information resources; instilling skills in carrying out educational research and scientific research work.	**4**								**v**					**v**	**v**	**v**
34	Purification of gaseous emissions	Purpose: to study the criteria for the quality (purity) of atmospheric air, the impact of pollutant emissions on the environment, determining the conditions for the effective dispersion of harmful emissions in the atmosphere and modern methods of gas purification. Contents: the nature of the impact of pollutants on the biosphere; principles of air quality regulation; classification of sources of pollutant emissions, determination of maximum permissible emissions; gas purification from dispersed particles and toxic gaseous ingredients; design and operating principle of modern gas cleaning equipment.	**4**					**v**		**v**		**v**						
35	Alternative heat sources	Purpose: provides basic theoretical knowledge and basic information about existing types of alternative heat sources, the basics of choosing	**5**			**v**		**v**								**v**		

		circuits, equipment and operation. Depending on the alternative type of energy, Contents: study of characteristics, design, circuit diagrams, devices and equipment depending on the type of alternative energy used (sun, wind, geothermal water, etc.), basic comparative information with traditional types of thermal energy generation.																
36	Use of water energy	Purpose: To teach students methods related to the use of surface water energy, ways of their practical implementation. Contents: consideration of the principles and features of the use of surface water energy, mastering the design methodology of the hydroelectric power plants in question, performing calculations necessary for the design; selection of the necessary turbines and generators, the correct choice of hydroelectric power plants for the use of water energy and determining their efficiency.	**5**						**v**						**v**			**v**
37	Energy-saving technologies in the heat and ventilation systems	Purpose: provides basic theoretical knowledge and practical skills on the possibility of using energy-saving technologies in various areas of the national economy using designs and devices based on the implementation of effective energy-saving measures. Contents: study of the state of energy saving in the structure of housing and communal services during the operation of engineering systems and networks, carrying out thermal engineering calculations to save thermal energy using methods and means for energy saving in heat and gas supply and ventilation systems.	**5**		**v**			**v**										**v**

38	Resource-saving technologies in water supply and sewerage systems	Purpose: to acquire deep theoretical knowledge about resource-saving technology for water supply and sanitation systems, as well as to be able to use this knowledge for various water management purposes. Resource saving in water supply, sewerage systems and water saving means in industry and public utilities. Contents: ways to effectively solve equipment related to the construction and reconstruction of water management buildings in the field of construction using resource protection technology in water and wastewater treatment. Economic aspects of water conservation application.	**5**			**v**		**v**										**v**	
39	Heating	The purpose of the discipline is to familiarize students with modern methods and technologies in the field of heating, as well as to teach them the basics of calculation, design and operation of heating systems, including the use of renewable energy sources. Students should master the skills of improving energy efficiency and developing environmentally friendly and cost-effective heating solutions. Content: The discipline covers the basics of calculation, design and operation of heating systems, analysis and use of renewable energy sources. The issues of saving thermal energy, increasing the energy efficiency of heating systems and their improvement for various types of buildings are considered. Special attention is paid to the development and implementation of environmentally	**6**		**v**		**v**			**v**									

		friendly technologies and cost-effective solutions in the field of heating.																	
Cycle of profile disciplines University component																			
40	Sanitary and technical devices of the building	Purpose: study of the basic schemes of cold and hot water supply to public buildings, the basics of sewer networks of public buildings; developing the ability to calculate the water supply system, determine the estimated costs of the internal water supply system; internal sewerage systems of public buildings. Contents: gives an idea of the sanitary and technical installations of buildings. The purpose of sanitary installations in buildings is to provide water for domestic needs and production processes, to remove wastewater, solid and liquid emissions.	**5**		**v**										**v**				
41	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**				**v**		**v**		**v**								
42	Producion 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**		**v**		**v**	**v**	**v**										

43	Producion 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**		v		v	v	v										
Cycle of profile disciplines Component of choice																			
44	Comfort of the room	Purpose: to form the calculation of elements in the analysis, design, thermal - aerodynamic parameters of the microclimate in the room. Content: mastering the rules in ensuring the microclimate, the study of technology with theoretical foundations, the acquisition of practical skills with theoretical knowledge in understanding the thermal and physical foundations of moisture transportation, processes, regulation of the thermal regime.	**4**		v					v	v								
45	Integrated use of water	Goal: is to acquire knowledge about the sustainable development of water resources and water management systems in conditions of high anthropogenic load on water bodies, drawing up a water balance when using water resources by economic sectors. Contents: integrated use of water resources by economic sectors, drawing up water balances, identifying and preventing the negative impact of economic activities on water resources, assessing economic, environmental and social damage from the harmful	**5**							v		v							v

		effects of water.																
46	Heat supply	The discipline "Heat supply" provides basic theoretical knowledge, the main provisions of the design and construction of heat supply systems. Fundamentals of calculation of heat release by types of heat consumption.	**6**		**v**			**v**						**v**				
47	Water resources management	Objective: to know the basics of water legislation and legal aspects of water resources management in the Republic of Kazakhstan; formation of students' ideas about the administrative and economic mechanisms of managing water management complexes. Contents: includes issues of water use, water consumption and protection of water resources of water management basins, the study of methods for analyzing water consumption and water disposal, factors and patterns of water consumption and water disposal of economic sectors in cities and towns.	**4**	**v**					**v**								**v**	**v**
48	Heat and gas networks	Purpose: students acquire theoretical foundations and practical skills on the technical condition and design of utility networks of cities and towns, familiarize themselves with methodological recommendations for the calculation and selection of basic equipment of heat and gas networks that meet modern regulatory requirements. Contents: consideration of issues of existing types, diagrams of heat and gas networks, sources of heat and gas supply, gas distribution stations, diagrams and routes of heat and gas networks; development of network	**5**			**v**	**v**						**v**					

		wiring diagram; main types of structural elements of networks, longitudinal profile of networks, basic rules for installation and operation of utility networks.																
49	Industrial water supply and sewerage	The purpose of the discipline is for students to acquire theoretical knowledge and practical skills in water treatment and sanitation of industrial enterprises. Discipline content: The discipline covers design, installation, study of schemes and methods of water treatment, softening, desalination, degassing, ion exchange and other methods, issues of industrial wastewater and precipitation disposal.	**6**				**v**			**v**							**v**	
50	Water treatment in boiler and heating networks	Purpose: to acquire theoretical knowledge and practical skills necessary to understand the processes in water treatment plants when processing water from steam boilers and make-up water from heating networks. Contents: the processes occurring in the circulating and boiler and heating networks are presented, as well as the processes and phenomena occurring in water treatment plants during the treatment of feed water of steam boilers and make-up water of heating networks. Methods of water treatment for boiler houses and heating networks.	**4**							**v**		**v**		**v**				
51	Water supply and sewerage special systems	Purpose: formation of a holistic view of special water supply and drainage systems, methods of desalination, desalination, softening, and degassing of natural water, drainage systems of sparsely populated areas, local wastewater treatment and individual treatment facilities.	**4**													**v**	**v**	**v**

		Content: the discipline covers modern special methods of drinking water preparation (salinization, iron removal, degassing). Students learn how to apply theoretical knowledge and skills in practice; use methods of determining counter indicators of the main settings of the system; calculation and selection of elements of special installations of engineering systems of water supply and drainage.																	
52	Ventilation and air conditioning	Purpose: acquisition by students of theoretical knowledge and practical skills in designing ventilation and air conditioning systems, principles of organizing air exchange and reconstruction of ventilation systems Content: reflects the current state of the theory and practice of applied aerodynamics and thermophysics in ventilation and air conditioning. The basics of calculating the design, adjustment and operation of ventilation and air conditioning systems in buildings and structures are outlined.	**6**		**v**				**v**		**v**								
53	Technology of natural water treatment	Purpose: training of specialists in the field of natural water purification, who can calculate and design natural water purification facilities, develop a technology for natural water purification. Contents: introduces methods and schemes for purifying natural waters; main facilities for the purification of natural waters; basic calculations for natural water treatment facilities; as well as methods and facilities for the preparation of drinking water, requirements for the quality of	**6**			**v**	**v**										**v**	**v**	

		drinking water, the choice of treatment method and schemes of treatment plants.																
54	Wastewater Treatment Technology	Purpose: to familiarize with the basic equipment in the design and operation of wastewater treatment technology, to develop a theoretical justification for treatment and to form ideas about their application in practice. Contents: determination of the types and composition of wastewater, selection of wastewater treatment methods, types and designs of the main structures, their basic calculations, preparation and selection of technological schemes of wastewater treatment plants are discussed in a wide range.	**6**			**v**	**v**									**v**	**v**	
55	Systems of hot water supply of buildings	Purpose: is to acquire theoretical knowledge and practical skills in the design, basics of design and operation of hot water supply systems. Contents: will master the practical use of skills in the design, installation and operation of hot water supply systems, as well as basic knowledge and skills in acquiring theoretical knowledge and practical skills in the design, basics of design and operation of hot water supply systems. Students learn how to analyze, calculate and design hot water systems.	**5**				**v**			**v**			**v**				**v**	
56	Disposal of wastewater and sludge	Purpose: to form knowledge about the treatment of wastewater and its sediment, i.e. about the design of the main installations and equipment in the recycling system. Contents: examines the issues of design and basic calculations, the main engineering installations of the	**5**							**v**						**v**	**v**	**v**

		wastewater and sludge disposal system, the patterns of wastewater transportation and their sediment, the principles of operation of sludge treatment plants.																
57	Occupational safety during the operation of engineering networks and structures	Purpose: to form the ability to comply with safety standards, develop documentation on Occupational Safety in the use of engineering networks and Devices, report the results of technical operation. Content: development of plans and schedules of works on water supply, heat supply, maintenance, current, major repairs of ventilation systems with the structure of engineering networks of settlements, regulatory materials under control.	**5**			**v**				**v**			**v**					
58	Rational water use	Purpose: to give an idea of the main methods for studying the qualitative and quantitative characteristics of water resources. Show the practical importance of geographical and hydrological study of water bodies for the economy of the state and for solving problems of conservation and nature. studying the problems of water consumption and water use by economic sectors. Contents: Knowledge of the characteristics of water resources, principles and methods of their rational use, management of their quantity and quality, knowledge of the requirements of various sectors of the economy for water, ways to save water during water consumption, ways to reduce the negative impact of water management construction on the environment.	**5**													**v**	**v**	**v**

59	Autonomous heat supply systems	Purpose: students acquire theoretical knowledge and practical skills in the basics of design, design and operation of autonomous heat supply systems, comparative characteristics of centralized and decentralized heat supply systems. Contents: consideration of issues of existing types of autonomous heat supply systems, schemes for connecting local heat consumer systems to heating networks, quarterly heating networks of an autonomous system, hydraulic calculation of decentralized systems, boiler room equipment of autonomous heat supply systems.	**5**		**v**			**v**						**v**				
60	Local water supply and sewerage systems	Purpose: is the acquisition of theoretical knowledge and practical skills in modern local water supply and sewerage systems used in the treatment of natural and low-capacity wastewater. Contents: studies issues of water supply and sewerage for enterprises, hydraulic calculation of water supply and drainage networks, determination of estimated costs and selection of structures. Drawing up a scheme for the treatment of natural and low-capacity wastewater, as well as for the operation of local water supply and sewerage facilities, solving promising issues of water consumption and sanitation.	5					v								v	v	
61	Ventilation of industrial buildings and structures	Purpose: acquisition by students of theoretical knowledge and practical skills in the field of design, construction and operation of ventilation systems, requirements for the air environment of industrial enterprises Content: The discipline	**5**		**v**		**v**		**v**									

		covers the basic provisions for creating and maintaining the required microclimate parameters and designing ventilation systems in production workshops, premises and structures. Selection of equipment, adjustment and operation of ventilation systems.																	
62	Closed water supply systems	Purpose: to train specialists capable of ensuring the efficient use of water resources used in industrial enterprises. Content: practical application of theoretical knowledge and skills acquired at manufacturing enterprises on the basis of creating technological cycles of water use, reducing water consumption, complying with environmental requirements, economical water consumption by the enterprise, equipping with self-sufficient and waste-free technology.	**5**					**v**	**v**		**v**								
63	Reconstruction and operation of water management systems and structures	Purpose: to provide students with the theoretical foundations of modern methods and methods of repair and maintenance of engineering networks of buildings and structures Contents: examines the issues of partial or complete replacement of water management systems and structures, their constructive modernization, the procedure for operation and maintenance of water management structures, regulatory, technical, sanitary and epidemiological support for water control and accounting, protection of water bodies during design, construction, reconstruction and commissioning.	**5**			**v**	**v**					**v**							
64	Operation of engineering systems	Purpose: Study of modern methods of technical operation of engineering	**5**			**v**	**v**			**v**								**v**	

	and structures	systems and structures, ways and methods of organizing management of the operation of systems and structures, the procedure for conducting inspections and technical examination of systems and structures, methods for assessing the technical condition of systems and structures. Contents: Formation of skills in organizing the work of an operating organization, applying in practical activities modern methods of inspection and assessment of the technical condition of systems and structures during operation.																
65	Transportation of water	The issues of water supply of settlements, systems, and schemes of water supply networks, as well as structures on the networks, are being studied. Hydraulic calculation of water supply networks, determination of the estimated costs of drinking water, and pipeline diameters.	**5**		**v**		**v**		**v**							**v**		
66	Ventilation	The purpose of the discipline is to familiarize students with modern methods and technologies in the field of ventilation, as well as to teach them the basics of calculation, design, commissioning and operation of ventilation systems in civil buildings. The discipline is aimed at mastering the theoretical and practical aspects of applied aerodynamics and thermophysics in air ventilation systems. Discipline content: The discipline covers the theory and practice of applied aerodynamics and thermophysics in ventilation systems, including the basics of calculation, design and	**5**		**v**		**v**			**v**								

		operation of ventilation systems in civil buildings. The key aspects of the aerodynamics of ventilation systems, as well as the principles of their installation and effective functioning in buildings and structures are considered. Special attention is paid to optimizing ventilation processes to ensure comfortable and safe indoor conditions.																
67	Rational use of gas	The discipline "Rational use of gas" forms students' general professional and professional competencies in the field of basic issues of gas classification, their rational use and rational consumption of gas fuel based on the use of modern achievements of science and technology, taking into account the prospects for the development of the gas industry. The economic efficiency, environmental and social consequences of the integrated use of hydrocarbon raw materials, analysis of the efficiency of the use of associated gas at gas processing plants and gas turbine power plants are considered.	**5**					**v**		**v**		**v**	**v**					
68	Installation of internal equipment of engineering systems	The purpose of the discipline is to form students' system of professional knowledge, skills and abilities in the field of organization and technology of installation of internal equipment of engineering systems. The objectives of the discipline are the study of regulatory documents for the installation of engineering systems equipment, as well as the selection of equipment, shaped parts and pipe fittings, as well as the study of conducting preliminary tests before	**5**		**v**		**v**		**v**										

		putting engineering systems into operation.																

6. Additional educational programs (Minor)

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