

#### 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: <u>6B07 Engineering</u>, <u>Manufacturing and Civil engineering</u>

Code and classification of training directions: <u>6B073 Architecture and Civil</u> 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 # 5 dated «28» <u>11</u> 2022.

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

Minutes # 3 dated «17» <u>11</u> 2022.

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

Full name	Academic degree/	Position	Workplace	Signature							
	academic title										
Chairperson of A	Academic Committee:										
Alimova	cand. tech. sciences	Head	Department of								
Kulyash		department,	"Engineering systems	1							
-		associate	and networks" IAC	Aun							
		professor	named after T. K.								
			Basenov								
Teaching staff:   Halkhabay cand_tech_sciences											
Halkhabay	cand. tech.sciences,	Associate	department	V. A.							
Bostandyk	docent	Professor	"Engineering systems	Your							
			and networks"								
Khoyshiev	cand. tech. sciences	Associate	department	$\sim$							
Amirkhan		Professor	"Engineering systems	Lobert							
			and networks"	10-0							
<b>Employers:</b>											
Zhumartova		headmaster	LLP "Research Center								
Aliya			Eco Zhobalau"	Her -							
Students:											
Bayarystanov		student	4st course	AND							
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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 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
- P1 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.
- P7 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

- U1 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 selfimprovement and personal growth.

#### 4. Passport of educational program

#### 4.1. General information

N⁰	Field name	Comments
1	Code and classification of	6B07 Engineering, Manufacturing and Civil engineering
	the field of education	
2	Code and classification of	6B073 Architecture and Civil engineering
	training directions	
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
		account the requirements of energy saving, ecology and life
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	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 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. 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.

	LO3 – Know the development trends and the importance of applied programs in engineering systems, methods of constructing flat projection models of
	three-dimensional space.
	LO4 – Possess a regulatory framework in the field of engineering surveys,
	planning, development and design principles for engineering networks of
	105 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.
	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.
	LO' - Own the methods of engineering calculations, apply them to solve
	specific problems, put them up for discussion and be able to defend the
	I O S = To be able to apply a system of fundamental knowledge
	(mathematical, natural science, engineering and economic) to identify.
	formulate and solve engineering problems.
	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.
	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 skins to calculate them. I O11 – 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.
	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.
	LO13 - 10 form a systematic knowledge of the basics of the organization,
	on corruption. Develop organizational and managerial skills in conducting
	business.
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

N₂	Discipline name	Short description of discipline	Amou				Ge	nerate	d learn	ing ou	itcom	es (cod	es)			
	-		nt of	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PO13
			credits													
		Cycle of gener	edux rel edux	ration	discir	lines	1				1					<u> </u>
			ired co	mnon	ant	Jines										
1	English language	After determining the level (according to the	10												<u> </u>	1
1		results of diagnostic testing or IFLTS results)	10	V	V											
		students are divided into groups and disciplines	,													
		The name of the discipline corresponds to the														
		level of English proficiency. When moving	r													
		from level to level prerequisites and														
		postrequisites of disciplines are observed.	-													
2	Kazakh (Russian) language	The socio-political, socio-cultural spheres of	10	14	10											
2		communication and functional styles of the	10	v	v											
		modern kazakh (russian) language are														
		considered. The course covers the specifics of														
		the scientific style in order to develop and	L													
		activate professional communication skills and	l													
		abilities of students. The course allows students	5													
		to practically master the basics of the scientific														
		style and develop the ability to produce a	L													
		structural and semantic analysis of the text.														
3	Physical culture	The purpose of the discipline is to master the	8	v	v											
		forms and methods of forming a healthy	r	•	•											
		lifestyle within the framework of the vocational														
		education system. Acquaintance with the														
		natural-science foundations of physical	L													
		education, possession of modern health-														
		improving technologies, the main methods of														
		independent physical education and sports.														
4	Information and	The task of studying the discipline is to acquire	5	v	v	v	v				v					
	Communication technology	theoretical knowledge about information	L													
		processes, new information technologies, local													1	
		and global computer networks, methods of													1	
		information protection; obtaining skills in the	•												1	
		use of text editors and spreadsheet processors:			1						1					1

							 					-
		creation of databases and various categories of										
		application programs.	~				 					
5	History of Kazakinstan	The course studies instorical events,	5	V	V	V						
		phenomena, facts, processes that took place on										
		the territory of Kazakhstan from ancient times										
		to the present day. The discipline sections										
		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 during the formation										
		of independence and at the present stage										
6	Philosophy	Philosophy forms and develops critical and	5	v	v	v						
		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.										
7	Socio-political knowledge	The purpose of the course: the formation of	3							v	v	v
	module (sociology, political	theoretical knowledge about society as an								•	•	
	science)	integral system, its structural elements,										
		connections and relationships between them, the										
		features of their functioning and development,				1						
		as well as the political socialization of students				1						
		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	Socio-political knowledge	It is designed to acquaint students with the	5	v						v		v
	module (culturalogy,	cultural achievements of mankind, to		•						•		•
	psychology)	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.										
	•	Cycle of gener	al edu	cation	discir	lines						
		Univer	rsity co	mnon	ent							
9			5	- npon								
	Fundamentals of anti-	The course introduces students to the	5								V	V
	corruption culture and law	improvement of socio-economic relations of									1	
		Kazakhstan society, psychological features of									1	
		corrupt behavior. Special attention is paid to the									1	
		tormation of an anti-corruption culture, legal									1	
		responsibility for acts of corruption in various									1	
		spheres. The purpose of studying the discipline										

		«Fundamentals of anti-corruption culture and law» is to increase public and individual legal awareness and legal culture of students, as well as the formation of a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to realize the values of moral consciousness and follow moral norms in everyday practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption.										
10	Fundamentals of economics and entrepreneurship	Discipline studies the foundations of economics and entrepreneurial activity from the point of view of science and law; features, problematic aspects and development prospects; the theory and practice of entrepreneurship as a system of economic and organizational relations of business structures; The readiness of entrepreneurs for innovative susceptibility. The discipline reveals the content of entrepreneurial activity, the stages of career, qualities, competencies and responsibility of the entrepreneur, theoretical and practical business planning and economic examination of business ideas, as well as the analysis of the risks of innovative development, the introduction of new technologies and technological solutions.	5								v	v
11	Fundamentals of scientific research methods	The purpose of studying the discipline is, on the basis of theoretical and practical knowledge, to ensure the adoption of evidence-based decisions in the performance of professional tasks. In the process of achieving the goal, tasks such as the formation of a scientific way of thinking, the acquisition of a complex of knowledge about the methodology of scientific knowledge and creativity, familiarization with the fundamental principles of planning and organizing scientific work in relevant areas.	5			v	v	v	v			
12	Ecology and life safety	The discipline provides theoretical and practical skills in the field ecology and safety, and is also	5			v	v	v	v			

		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										
		conditions.										
		Cycle of	basic	discipli	nes							
	1	Univer	sity co	mpone	nt				•			
13	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		v			v	V			
14	Mathematics II	The discipline is a continuation of Mathematics 1. The sections of the course include: elements of linear algebra and analytical geometry. 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.	5		v			v	V			
15	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	5		v			v	v			

		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.												
16	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		v	v				V				
17	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 networks of housing and communal services in cities and towns.	4				v	v		v				
18	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	V						V		V		
19	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	6	V			v		v		v			

		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.										
20	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	v			
21	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			V		V	v			
22	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			V			
23	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		V		V			V		

24	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		V	V				V				
25	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							v	v		v	
26	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	f basic	discip	lines			 						 
	1	Com	ponent	of cho	oice	1	1		1					 
27	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		
28	Pumps and pump stations	The discipline "Pumps and pump stations" provides general information about pumps, pumping stations, the working parameters of the	5					v			v	v		

		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.									
29	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	
30	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		
31	Heat and Mass Exchange	The special course is devoted to presentation of phenomena of heat and mass transfer. 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.	5				V	v		v	
32	Water intake facilities	The discipline "Water intake facilities" gives an idea of the role and importance of the location	5		v	v			v		

		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.												
33	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			v		V				v		
34	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			v		V				v	v	
35	Heat-generating installations	Discipline "Heat-generating plants" gives an idea of the properties and characteristics of 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.	5					V		v	v			
36	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			V	v						v	
37	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		v	v			v		v			

38	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		v	v		v				v		
39	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	v						v			v	
40	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 harmful emissions in the atmosphere and modern methods of gas purification.	4				v		V		v			
41	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		
42	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	5			v			v	v				

		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												
43	Energy-saving technologies in the heat and ventilation systems	plants. 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		
44	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 industry and in agriculture. Economic aspects of water conservation application.	5				v				v	v		
		Cycle of Unive	profile rsity co	discip	olines ent									
45	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		V						v		V	
46	Technology of installation and construction works	The discipline studies the theoretical foundations, modern methods and methods of	5					v	V				v	

47		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.												
47	Producion practice I	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					
48	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	discip	lines									
40		Comp	onent	of choi	ce						1			
47	Comfort of the room	The discipline "Comfort of the room" provides a systematic presentation of the provisions that 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.	•							V	V		v	
50	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	4				v	v	v		V			

		water disposal, factors and patterns of water consumption and water disposal in industries in cities and towns.											
51	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		v	V		v			v		
52	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		v	v	v				v		
53	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 treatment plants during the processing of feed water of steam boilers and make-up water of heat networks.	4				v		v	v			
54	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		v	V	v				v		
55	Ventilation and air conditioning	The discipline "Ventilation and air conditioning" reflects the current state of the theory and practice of applied aerodynamics and	6	v			v					v	

		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.										
56	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			v		V		v		
57	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 improvement and development of heating systems, the use of renewable energy sources, saving thermal energy for heating buildings are considered.	6	V	v		V		v		v	
58	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			v		V		v		

59	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		v							v		v	
60	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							v	V		v		
61	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	v				v				V	V		
62	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				v						v	v	
63	Autonomous heat supply systems	The discipline "Autonomous heat supply systems" studies the basics of heat supply of buildings and structures. Types and characteristics of heating devices, pumps, boiler installations and hydraulic calculation of heat supply systems.	5			v			v		V				
64	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			V	v		V				V		
65	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	5		V				v			v			

		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.									
66	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		v	v	v		V		

#### 5. Curriculum of educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named



APPROVED ement Board-er K.Satpayev M Be egentaev 2023 y.

CURRICULUM of Educational Program on enrollment for 2023-2024 acade

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 o	of study	: 4 yea	ars			Academi	ic degree:	Bachelor	of engine	eering an	d techno	ology	
	Name of disciplines	Cycle	Total	Total	Classro	SIS	Form	AI	location of	face-to-fa	ce trainin	ig based o	n course	s and sem	esters
Discipline			amou nt in	hour	om amount	(includ ing	of control	I co	ourse	II co	ourse	III c	ourse	IV	course
code		12.	credit		lec/lab/p	TSIS)		1	2	3	4	5	6	7	8
						hours		semester	semester	semester	semeste	semeste	semest	semester	semester
CYCLE	OF GENERAL EDUCATION DISC	IPLINES (	GED)	1											
				M-1.	Module	of lang	uage tra	aining	1						_
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						
	(,		1	M-2.	Module	of phy	sical tra	ining							1
KFK 101-	Physical Culture	GED RC	8	240	0/0/8	120	Diferedit	2	2	2	2				
104	Thysical Canale	old, no	M	2 M	adula of	120	ation to	hualogu	-	-	-				
			M	-3. M	odule of	Inform	ation te	chhology							_
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5				
			M-4	. Mod	ule of so	cio-cul	tural de	velopme	nt						
HUM 137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5						
HUM 132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
	Socio-political knowledge module														
HUM 120	(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				_	
		M-5. Mod	ule of a	anti-c	orruptio	n cultu	re, ecolo	gy and li	ife safety	base					
HUM136	Fundamentals of Anti-Corruption Culture														
1010100	Fundamentals of Economics and														
MNG489	Entrepreneurship	GED,CCH	5	150	2/0/1	150	E			5					
CIV970	Fundamentals of scientific research methods														
HYD438	Ecology and life safety	1													
CYCLE	OF BASIC DISCIPLINES (BD)														
		M	-6. Mo	dule	of physic	al and	mathem	atical tra	aining						
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						
				M-	7. Modu	e of ba	sic trair	ing							
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					
HYD404	Pumps and fans	PD CCH	5	150	1/1/1	105	F				5				
HYD405	Pumps and pump stations	bb, cen	5	150	1/1/1	105	Б				-				
CIV591	Architecture and building structures	BD, UC	5	150	1/0/2	105	E					5			
HYD192	Heat transfer in fences	BD CCH	5	150	1/1/1	105	E				5				
HYD191	Water quality indicators -						_								
HYD401	Heat and Mass Exchange	BD, CCH	5	150	2/0/1	105	Е					5			
HYD407	Water intake facilities				1/0/2										_
AAP184	Educational practice	BD, UC	2						2						
			M-8.	Mod	ule of en	gineeri	ng netw	ork desig	gn						
HYD449	BIM technology in engineering systems	BD, UC	5	150	1/0/2	105	E			_		5			
HYD410	Gas supply	BD. CCH	5	150	1/0/2	105	E					5			
HYD411	Sewer networks					_									
HYD406	Heat-generating installations	BD, CCH	5	150	1/0/2	105	E					5			
HYD434	Integrated use of water		-	-	2/0/1										
HYD452	Heat supply	BD CCH	6	180	2/1/1	120	F							6	
111/12454	Water supply systems	bb, cen		100	2000	120	-								
HYD167	Economics of engineering systems	BD, UC	5	150	2/0/1	105	Е							5	

					M-9. N	Iodule '	'R&D'								
HYD451	Fundamentals of scientific research in water management	BD CCH	4	120	2/0/1	75	F								
HYD453	Purification of gaseous emissions	,		180	20071	1.2	-					1			
HYD412	Alternative heat sources				-						-				
HYD413	Use of water energy	BD, CCH	5	150	1/0/2	105	E						5		
HYD416	Energy-saving technologies in the heat and									-					-
HYD417	Resource-saving technologies in water supply and sewerage systems	BD, CCH	5	150	2/0/1	105	E						5		
CYCLE	OF PROFILE DISCIPLINES (PD)														
			N	1-10. N	Iodule	of profe	ssional	activity							
HYD188	Sanitary and technical devices of the building	PD, UC	5	150	1/0/2	105	E						5		T
CIV955	Technology of installation and construction works	PD, UC	5	150	2/0/1	105	E							5	
HYD457	Comfort of the room	PD. CCH	4	120	2/1/0	75	Е						4		
H1D438	water resources management		MI	1 14										L	
HVD421	Heat and one activity		MI-1	1. MIOC	ule of e	ngineer	ing sys	tems desi	gn						
HYD421	Inductrial water supply and severage	PD, CCH	5	150	1/0/2	105	Е						5		
HYD459	Water treatment in boiler and heating					_				-					
HYD460	networks Water supply and sewerage special systems	PD, CCH	4	120	1/0/2	75	E						4		
HYD455 HYD456	Ventilation and air conditioning	PD, CCH	6	180	2/1/1	120	E							6	
HYD461	Heating														
HYD462	Wastewater treatment technology	PD, CCH	6	180	2/1/1	120	E							6	
HYD428	Systems of hot water supply of buildings	PD, CCH	5	150	1/0/2	105	E							5	
1110427	Disposal of wastewater and sludge				_										
			M-	12. Eq	uipment	and te	chnolog	y modul	e					-	
1YD4//	Occupational safety during the operation of engineering networks and structures	PD, CCH	5	150	1/1/1	105	Е								5
11D431	Rational water use														
JVD420	Autonomous heat supply systems	PD, CCH	5	150	1/0/2	105	Е			_					5
HYD432	Ventilation of industrial buildings and	PD, CCH													
IYD433	Closed water supply systems		5	150	1/0/2	105	E								5
AAP192	Production practice I	PD UC	2								2				
AAP193	Production practice II	PD UC	3				-				2		2		
AAP195	Undergraduate practice	PD UC	3										3		
	statute practice	PD, UC	4	M.12	Model	office	lattest	ation							4
01100				M-13.	woould	e or rina	ii attest	ation							
CA108	Final examination	FA	8						-			-			8
10500	A 414		M-14	. Mod	ule of ac	Iditiona	I types	of traini	ng						_
AAP500	Military affairs	ATT	0											_	
	Total based on UNIVERSITY:							31	29	28	32	29	31	33	27

	Cycles of disciplines		C	redits	_
Cycle code		component (BC)	university component	component of choice (CCH)	Total
GED	Cycle of general education disciplines	51	5		56
BD	Cycle of basic disciplines		67	45	170
PD	Cycle of profile disciplines		19	45	170
	Total for theoretical training:	51	91	90	232
FA	final attestation	8			8
	TOTAL:	59	91	90	240

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № 5 24 november 2022 y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 3 17 november 2022 y.

Decision of the Academic Council of the Instituteof A&C. Protocol No2 "4" 10 2012y.

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. Kuspangaliev

B. Zhautikov

K. Alimova

A. Zhumartova

#### 6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	<b>Recommended</b> 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