



Institute of «Architecture and Construction named after T.K. Basenov»

Department of «Engineering systems and networks»

EDUCATIONAL PROGRAM

7M07304 «Engineering systems and networks»

Code and name of educational program

Code and classification of the field of education: **7M07 Engineering, manufacturing and civil engineering**

Code and classification of training directions: **7M073 Architecture and civil engineering**

Group of educational programs: **M127 Engineering systems and networks**

Level based on NQF: 7

Level based on IQF: 7

Study period: 2 years

Amount of credits: 120

Almaty 2025

Educational program 7M07304 "Engineering systems and networks" was approved
code and name of educational program
at the meeting of K.I. Satbayev KazNRTU Academic Council

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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 7M07304 «Engineering systems and networks» was
code and name of educational program
developed by Academic committee based on direction «Architecture and civil
engineering».

Full name	Academic degree/ academic title	Position	Workplace	Signature
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List of abbreviations and designations

NJSC KazNRTU named after K.I.Satbayev - Non-profit Joint Stock Company
"Kazakh National Research Technical University named after K.I.Satpayev";
SCSE – State compulsory standard of education of the Republic of Kazakhstan;
EP – educational program;
SIS – student independent study (student, master student, doctoral student);
TSIS – independent work of a student with a teacher (student, master student, doctoral student) ;
WC – working curriculum;
CED – catalog of elective disciplines;
UC – university component;
CC – component of choice;
NQF – national qualifications framework;
IQF– industry qualifications framework;
LO – learning outcomes.

1. Description of educational program

Within the framework of the Master's degree 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, skills and competencies acquired by undergraduates 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 ECTS credit (credit) units. The structure of the Master's degree program is formed from various types of educational and scientific work that determine the content of education, and reflects their relationship, measurement and accounting.

The purpose of the educational program is to achieve the provision of high-quality educational services in the field of postgraduate education, leadership in the national training space in the specialty 7M07304 "Engineering systems and networks" through the implementation of the principles of the Bologna Process and modern quality standards.

The objective of the educational program - is to train highly qualified competent specialists in the construction and engineering sector of the economy of the Republic of Kazakhstan, who are able to quickly adapt to rapidly changing market conditions and innovative trends.

The list of elective component disciplines is determined by the university independently. This takes into account the expectations of employers and the needs of the labor market. Masters of the specialty 7M07304 "Engineering systems and networks" can perform the following types of professional activities:

- Settlement and design and technical and economic;
- organizational and managerial;
- production, technological and operational;
- legal, expert and consulting - research;
- educational (pedagogical).

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

Organizational and managerial activities:

- organization of the work of the labor collective of performers with the creation of the necessary conditions, equipping (providing) production with labor and material resources, making optimal management decisions in various production conditions;
- finding optimal solutions in the event of labor disputes over staffing, wages, cost and quality of performance of various types of work, ensuring life safety, labor protection and compliance with environmental safety in production areas;
- assessment of production and non-production costs to ensure the quality of products of construction and repair production;

- implementation of technical control and quality management in transport construction.

Production-technological and operational activities:

- planning and solving technological problems encountered in the production process;

- efficient use of materials and raw materials, equipment, machinery, modern computer programs for calculations and design of technological process parameters;

- engineering and technical operation of buildings and structures of industrial and civil construction or engineering systems.

Scientific, experimental and research activities:

- implementation of fundamental and applied scientific research in the study of engineering systems;

- creation of new production technologies;

- implementation of experimental design developments;

- production of analysis of the state and dynamics of objects of activity using modern methods and methods;

- production of scientifically based experimental studies of engineering systems;

Legal, expert and consulting activities:

- possession of basic knowledge in the field of civil, financial, commercial and other branches of law;

- the ability to navigate the current legislation and the ability to apply certain legal norms in practice;

- conducting expertise and providing consulting assistance in various production situations.

Educational (pedagogical) activity:

- knowledge of the functions of teaching courses in basic disciplines, technology, organization, planning and management of engineering systems, performing academic work as a teacher (instructor) in institutions of secondary and vocational education (schools, gymnasiums, lyceums, colleges).

2. Purpose and objectives of educational program

Purpose of EP: The purpose of the educational program is to achieve the provision of high quality educational services in the field of postgraduate education, leadership in the national space for training personnel under the educational program 7M07304 "Engineering Systems and Networks" (scientific and pedagogical direction) through the implementation of the principles of the Bologna process and modern quality standards.

Tasks of EP: training of highly qualified competent specialists in the construction and engineering sector of the economy of the Republic of Kazakhstan, able to quickly adapt to rapidly changing market conditions and innovative trends.

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

3. Requirements for evaluating the educational program learning outcomes

A graduate who has mastered master's degree programs should have the following general professional competencies:

- the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;
- the ability to formulate research goals independently, establish the sequence of solving professional tasks;
- the ability to apply in practice the knowledge of fundamental and applied sections of disciplines that determine the orientation (profile) of the master's degree program;
- the ability to professionally choose and creatively use modern scientific and technical equipment to solve scientific and practical problems;
- the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities;
- proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;
- willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;
- willingness to communicate orally and in writing in a foreign language to solve the tasks of professional activity.

A graduate who has mastered the master's degree program must have professional competencies corresponding to the types of professional activities that the master's degree program is focused on:

Research activities:

- the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of sciences and specialized knowledge obtained during the development of the master's degree program;
- the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;
- the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of engineering systems of buildings and structures;

Scientific and production activities:

- the ability to independently carry out production and scientific field, laboratory and interpretive work in solving practical problems;
- the ability to professionally operate modern field and laboratory equipment and devices in the field of the master's degree program;
- the ability to use modern methods of processing and interpreting complex information to solve production problems;
- project activities:
- the ability to independently draw up and submit projects of scientific research and scientific production works;
- readiness to design complex research and scientific-production works in solving professional tasks;

Organizational and managerial activities:

- readiness to use practical skills in organizing and managing research and scientific-production works in solving professional tasks;
 - readiness for the practical use of regulatory documents in the planning and organization of scientific and production work;
 - scientific and pedagogical activity:
 - the ability to conduct seminars, laboratory and practical classes;
 - the ability to participate in the management of scientific and educational work of students in the field of engineering systems of buildings and structures.
- When developing a master's degree program, all general cultural and general professional competencies, as well as professional competencies related to those types of professional activities that the master's program is focused on, are included in the set of required results of mastering the master's program.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	7M07 «Engineering, manufacturing and civil engineering»
2	Code and classification of training directions	7M073 «Architecture and civil engineering»
3	Educational program group	M127 «Engineering systems and networks»
4	Educational program name	7M07304 «Engineering systems and networks»
5	Short description of educational program	Within the framework of the Master's degree 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, skills and competencies acquired by undergraduates 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 ECTS credit (credit) units. The structure of the Master's degree program is formed from various types of educational and scientific work that determine the content of education, and reflects their relationship, measurement and accounting.
6	Purpose of EP	The purpose of the educational program is to achieve the provision of high quality educational services in the field of postgraduate education, leadership in the national space for training personnel under the educational program 7M07304 «Engineering Systems and Networks» (scientific and pedagogical direction) through the implementation of the principles of the Bologna process and modern quality standards.
7	Type of EP	New
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	No
11	List of competencies of educational program	General professional; Professional (research activities, organizational and managerial activities, scientific and production activities, project activities, scientific and pedagogical activity);

12	Learning outcomes of educational program	LO1 - By integrating knowledge, make judgments and make decisions based on incomplete or limited information. LO2 - Integrate knowledge gained in different disciplines to solve research problems in new unfamiliar conditions. LO3 - Apply interactive teaching methods. LO4 - Be fluent in a foreign language at a professional level, allowing to conduct research and teach special subjects in universities. LO5 - Critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena. LO6 - Use the acquired knowledge for the original development and application of ideas in the context of scientific research. LO7 - Apply the knowledge of pedagogy and psychology of higher education in their teaching activities. LO8 - To carry out information-analytical and information-bibliographic work with the involvement of modern information technologies. LO9 - Think inventively and creatively to solve new problems and situations. LO10 - Summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note and other materials.
13	Education form	Full - time
14	Period of training	2
15	Amount of credits	120
16	Languages of instruction	Kazakh, russian, english
17	Academic degree awarded	Master of Technical Sciences
18	Developers and authors	Alimova K.K., Berdali M.N., Tlesh D.A.

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
Cycle of basic disciplines University component													
1	Foreign language (professional)	The course is aimed at studying the main problems of scientific knowledge in the context of its historical development and philosophical understanding, the evolution of scientific theories, principles and methods of scientific research in the historical construction of scientific paintings of the world. The discipline will help to master the skills of developing critical and constructive scientific thinking based on research on the history and philosophy of science. At the end of the course, undergraduates will learn to analyze the ideological and methodological problems of science and engineering and technical activities in building Kazakhstan's science and the prospects for its development.	3	v			v		v	v			
2	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image,	3	v	v			v			v		

		analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.											
3	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3					✓		✓		✓	✓
4	Higher school pedagogy	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select the content of training sessions. Organize the educational process on the basis of credit technology of education.	3	✓				✓		✓		✓	
5	Pedagogical practice	Pedagogical practice is conducted in order to form practical skills of teaching and learning methods. At the same time, undergraduates are involved in conducting undergraduate classes at the discretion of the faculty	6	✓		✓					✓		
Cycle of basic disciplines													

Component of choice												
6	Innovative technologies for natural and waste water treatment	Purpose: To study innovative methods of purification of natural and waste waters, using the latest advances in science Contents: Main types of membrane separation technologies in natural and waste water treatment. Principles of membrane separation, process organization. Microfiltration and ultrafiltration. Nanofiltration and its applications for water treatment. Pre-purification of water before reverse osmosis installations. Desalination of natural water. Reverse osmosis technology. Technological calculations and selection of equipment. Types of membranes, device designs.	5	v	v	v						v
7	Methods for optimizing the parameters of heat and gas supply systems and heat generating plants	Purpose: acquisition by students of theoretical and practical skills on the technical condition of heat and gas supply systems. Familiarization with the methods for selecting heat generating plants, taking into account measures to optimize parameters for. heating networks. Contents: consideration of schemes of heat generating plants and heat and gas supply systems; selection of optimal types of main equipment; development of optimal installation diagrams of heat and gas networks using modern structural devices and elements in accordance with modern requirements.	5	v	v				v			v
8	Modern technologies and equipment of water supply and sewerage systems	Purpose: To study technologies using modern purification processes and the use of modern equipment to purify water from industrial contaminants. Contents: Water treatment technologies for industrial enterprises, wastewater treatment, disinfection and reuse of wastewater	5	v				v	v			v

		from industrial enterprises using modern methods and requirements for the quality of purified water. Calculation of local treatment facilities, selection of equipment, preparation of process flow diagrams. Calculation of maximum permissible indicators, rules for wastewater discharge.											
9	Heat generators and autonomous heat supply of buildings	Purpose: training highly qualified specialists in the design and operation of heat generators and autonomous heat supply systems for buildings. Contents: general principles of design, design and operation of heat generators and autonomous heat supply systems for buildings. Study of the principles of fuel supply, water treatment and water chemistry of heat generators. The main types of autonomous heat supply, including those using renewable energy sources. Technical characteristics of the main types of heat generators.	5	✓	✓							✓	✓
10	Innovative design solutions for water supply and sewerage systems and structures	Purpose: To study innovative design and calculation methods using new information technologies and programs for natural and waste water treatment facilities Contents: Construction standards. Pre-design research. Research at the detailed design stage. Feasibility studies of decisions made on systems and schemes of water supply and sewerage structures. Calculations of water intake structures, main and city water supply and sewerage networks, planning solutions for treatment facilities. Determination of economic design indicators, cost of water.	5	✓		✓			✓			✓	
11	Effective environmental protection	Purpose: formation of theoretical knowledge and practical skills, as well as advanced technologies in the field of environmental protection equipment	5	✓	✓				✓				✓

	technologies in heat and gas supply and ventilation systems	of HaV systems, skills in mastering methods for selecting and calculating environmentally protective technologies in order to prevent the negative impact of HaV systems on the quality of the environment. Contents: modern methods of researching technological processes of generating thermal and electrical energy from the perspective of impact on the environment. Anthropogenic impact of HaV systems on the biosphere. Characteristics of thermal power engineering facilities as environmental pollutants, determination of the degree of purification of emissions from power equipment.											
12	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5						v		v		v
13	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5			v			v			v	
Cycle of profile disciplines													

University component												
14	Methods for calculating the energy efficiency of buildings and structures	Purpose: formation of theoretical knowledge on methods of calculating energy efficiency of buildings and structures Contents: regulatory and legal framework for energy saving, energy efficiency classes of buildings, energy audit and audit stages, renewable energy sources for improving energy efficiency of buildings, calculation of methods for increasing energy efficiency of construction facilities, energy-saving building structures and systems, study of statistical, documentary and technical information during an energy survey.	5		v				v			v
15	Means and methods of experimental research	Purpose: Study of theoretical and practical methods used in scientific research and the fundamentals of methodological principles for conducting research projects. Contents: Methods and methodology of scientific research. Means and methods of experimental research. Goals and objectives of the experiments. Analysis of theoretical and experimental research. General scientific research methods. Errors and types of measurements in experimental studies. Scientometric indicators: impact factor, Hirsch index. Writing and registration of graduation and scientifically qualifying works, dissertations.	5	v	v							v
16	Research practice	The research practice of the undergraduate is conducted in order to familiarize himself with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.	8	v	v	v						

Cycle of profile disciplines Component of choice													
17	Modernization and reconstruction of water drainage systems	Objective: formation of knowledge on the processes of modernization and reconstruction of water disposal systems in order to improve, upgrade, update the facility, bring it into compliance with new requirements and standards, technical conditions, quality indicators. Contents: The processes of modernization and reconstruction include not only technical changes, but also changes in the organizational and management structure of the water disposal system, as well as the introduction of new technologies and methods of work. It implies not only the introduction of new technical capabilities, but also an increase in the efficiency of using existing resources and improving the work processes of the water disposal system. As well as automation and telemetry systems, for effective management of the operation of structures. Calculation and measurement of technological parameters of structures and networks. Ensuring the reliability of equipment and structures in emergency situations.	5	v	v			v	v				
18	Topical problems of modern heat and gas supply and ventilation systems	Purpose: to study the main problems in heat and gas supply and ventilation systems. Contents: current topical problems in heat and gas supply and ventilation systems, scientific analysis of the inefficiency of systems, electricity costs and heat loss, calculations of methods for reducing heat losses in heat and gas supply and ventilation systems, the use of modern resource-saving equipment in heat and gas supply and ventilation	5	v		v		v				v	

		systems, improving the operational reliability of systems.											
19	Start-up and adjustment of water supply and sewerage facilities	Purpose: formation of theoretical knowledge and practical skills for the start-up and commissioning of water supply and sewerage facilities Contents: regulatory documents on the start-up and commissioning of water supply and sewerage facilities; carrying out design indicators with the current technical characteristics of the structure; rules for the commissioning of water supply facilities: networks, settling tanks, filters, pumps, reagent facilities; sewage facilities: networks, pumping stations, settling tanks, aerotanks.	5	✓	✓				✓				✓
20	Rational use of heat and gas in construction	Purpose: to master the main issues of rational use of heat and gas in construction. Contents: physico-chemical properties of combustible gases, study of the uninterrupted operation of gas supply and heat supply systems, taking into account the operation of main and auxiliary equipment, issues of 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 and the heat supply system, issues of increasing the rational use of heat.	5		✓	✓			✓				✓
21	Systems of protection of water resources	Purpose: to teach basic calculation techniques and methods for designing water management systems that rationally use water resources, developing measures to reduce unproductive water consumption and designing structures to protect water sources from depletion, pollution and clogging. Contents: basic knowledge about the sustainable development of water resources and water management systems in conditions of high	5		✓			✓				✓	

		anthropogenic load on water bodies. The influence of economic, environmental and social factors on the development of water management.											
22	The economy of heat and energy in heat and gas supply and ventilation systems	Purpose: acquisition by students of theoretical and practical skills on the technical condition of heat and gas supply and ventilation systems. Energy saving concept and objectives. Saving heat and energy in construction and housing and communal services Contents: methods of heat and energy generation in a heat source; volumes of heat energy consumption in buildings; ways to reduce energy consumption by buildings and save energy in everyday life; reconstruction and modernization of district heating systems; heating and ventilation systems of buildings.	5					✓	✓		✓		✓
23	Modern computer calculations of heat supply, gas supply and ventilation systems	Purpose: to familiarize undergraduates with basic computer calculations for selecting optimal solutions for heat, gas supply and ventilation systems using special programs. Content: general information about the design of systems of modern heat sources, equipment, methods for calculating heat and gas supply systems, ventilation, selection of reliable and optimal systems, performing calculations of engineering systems for research during design or production activities. Computer calculations of equipment for heating systems.	5			✓					✓		✓
24	Modern computer calculations of water supply and sewerage systems	Purpose: to familiarize undergraduates with basic computer calculations for choosing optimal solutions for water supply and sanitation systems. Content: general information about the design of water supply and sewerage systems, the use of computer programs to analyze the results of the operation of structures and systems. Effective ways	5			✓					✓		✓

		to determine the optimal diameters of the water supply network, speed up the operation of the system using computer programs for calculating and modeling water supply and sewerage systems. Organization of work of dispatch services in housing and communal services.											
25	Modern methods modernization of water treatment facilities	Purpose: To study modern types of reconstruction of water treatment and wastewater treatment facilities, in conditions of increasing the productivity of structures and tightening requirements for the quality of treated water. Contents: Technologies for purification of pollution of natural and anthropogenic origin by oxidation-sorption methods. Modern filter materials and reagents, modernization of the designs of water treatment facilities. Modern methods for treating natural and wastewater sludge. Use of sewage sludge. Environmental requirements for the quality of treated water.	5						✓		✓		✓
26	Adjustment and reconstruction of heat supply systems	Purpose: formation of theoretical knowledge and practical skills for the adjustment and reconstruction of heat supply systems in accordance with modern requirements Contents: normative documents on the start-up and reconstruction of heat supply systems; carrying out design indicators with the current technical characteristics of the structure; rules for the commissioning of heat supply systems; methods of calculation of heat flows; basic methods of reconstruction of heat supply systems.	5		✓				✓			✓	✓
27	Topical problems of modern heat and gas supply and ventilation	Purpose: to study the main problems in heat and gas supply and ventilation systems. Contents: current topical problems in heat and gas supply and	5	✓				✓	✓				✓

	systems	ventilation systems, scientific analysis of the inefficiency of systems, electricity costs and heat loss, calculations of methods for reducing heat losses in heat and gas supply and ventilation systems, the use of modern resource-saving equipment in heat and gas supply and ventilation systems, improving the operational reliability of systems.											
28	Current problems of operation of modern sewerage systems	Objective: Formation of knowledge on the operation of sewerage systems to maintain their operability taking into account wear and tear during operation, diagnostics of the technical condition of sewerage system objects and repairs in accordance with new requirements and technical conditions. Contents: Current problems of operation consist of protecting and restoring ecosystems associated with water: for sewerage systems, it consists of draining and cleaning wastewater from a settlement. Technical operation of sewerage systems in settlements, the organization of the sewerage system includes organizational and technical measures for inspection, technical examination, technical control, all types of repairs carried out periodically according to the approved plan of technical operation, as well as unscheduled repairs to eliminate accidents and malfunctions. Control at all stages of the technological cycle to ensure the quality of treated wastewater, measures aimed at ensuring the required amount of treated wastewater in cases of non-compliance with their quality established standards and rules.	5		v			v	v			v	

29	Retechnologization of wastewater treatment facilities	Purpose: Study the reasons for retechnologization, goals and objectives. Methodological principles of retechnologization, stages of inspection of a wastewater treatment plant. Contents: The concept of retechnologization. Factors influencing the retechnologization of a wastewater treatment plant. Goals and objectives of retechnologization. Development of a retechnology program. Methodological foundations of retechnologization. Methods for analyzing the condition of existing structures. Desk examination, field examination, In-depth examination. Modern methods of wastewater treatment. Technological schemes for wastewater treatment. Improvement of wastewater treatment processes.	5			v		v					v	v
30	Rational use of energy resources	Purpose: master's students acquire theoretical knowledge and practical skills in matters of rational use of energy resources by heating, ventilation and air conditioning systems. Contents: Structure of the energy balance, general principles of saving fuel and energy resources, list of measures to save fuel and energy resources in heat-generating installations and principles of their implementation. Methods and means of energy saving in heating and ventilation systems, methods of heat recovery, general principles of energy technology use of various wastes.	5		v	v							v	v