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

**Department of «Engineering systems and networks»**

# EDUCATIONAL PROGRAM

## 8D07304 «Engineering systems and networks»

**Code and name of educational program**

Code and classification of the field of education: **8D07 Engineering, manufacturing and civil engineering**
Code and classification of training directions: **8D073 Architecture and civil engineering**
Group of educational programs: **D127 Engineering systems and networks**
Level based on NQF: **8**
Level based on IQF: **8**
Study period: 3 years
Amount of credits: **180**

**Almaty 2025**

Educational program 8D07304 «Engineering systems and networks» was approved
code and name of educational program
at the meeting of K.I. Satbayev KazNRTU Academic Council

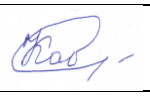
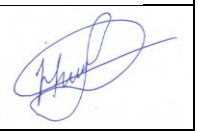
Minutes №10 dated «06» 03 2025.

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

Minutes №3 dated «20» 12 2024.

Educational program 8D07304 «Engineering systems and networks» was
code and name of educational program
developed by Academic committee based on direction 8D073 «Architecture and civil engineering».

| Full name | Academic degree/ academic title | Position | Workplace | Signature |
|---|---|---|---|---|
| **Teaching staff:** | | | | |
| Alimova Kulyash Kabpasovna | cand. tech. sciences | Head of Department | NPJSC «Kazakh National Research Technical University named after K.I.Satbayev», department "Engineering systems and networks" | |
| Halkhabay Bostandyk | cand. tech.sciences, docent | Associate Professor | NPJSC «Kazakh National Research Technical University named after K.I.Satbayev», department "Engineering systems and networks" | |
| Khoyshiev Amirkhan | cand. tech. sciences | Associate Professor | NPJSC «Kazakh National Research Technical University named after K.I.Satbayev», department "Engineering systems and networks" | |
| **Employers:** | | | | |
| Zhumartova Aliya | | headmaster | LLP "Research Center Eco Zhobalau" | |

| **Students:** | | | | |
|---|---|---|---|---|
| Kabaev Batyrkhan | | Student | 3rd course, EP ESaN |  |
| Nurzhigit Kazybek | | Master's student | 2nd course, EP ESaN |  |

# Table of contents

## 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

The PhD doctoral program is a professional educational program of postgraduate education aimed at training scientific and pedagogical personnel with the award of the degree of Doctor of Philosophy PhD with a standard training period of at least 3 years. The educational program for the preparation of a Doctor of Philosophy PhD involves fundamental educational, methodological and research training, and in-depth study of disciplines in the field of engineering systems of buildings and structures.

In the process of studying in the doctoral program, PhD students can realize all the opportunities for scientific activity, in particular, they have:

- access to all library resources and electronic catalogs;
- possibility of consultations with their scientific supervisors, other professors;
- the opportunity to communicate and consult with leading scientists from many foreign universities;
- the possibility of passing an internship abroad.

The PhD doctoral program is a professional educational program of postgraduate education aimed at training scientific and pedagogical personnel with the award of the degree of Doctor of Philosophy PhD with a standard training period of at least 3 years.

## 2. Purpose and objectives of educational program

**Purpose of EP:** The purpose of the educational program is to train highly qualified specialists with basic competencies in the field of solving organizational and production tasks in the implementation of innovative, research projects, the formation of personnel in the field of engineering systems and networks, covering modern energy and resource-saving technologies.

**Tasks of EP:** The main objectives of the educational program Doctor of Philosophy PhD or doctor in the profile of OP 8D07304 "Engineering systems and networks" are:

− ensuring the quality of education through the presentation of mandatory requirements for the level of training of doctoral students and educational activities of higher educational institutions;

− regularization of the rights of subjects of educational activity;

− improving the objectivity and informativeness of the assessment of doctoral students' training and the quality of educational programs;

− creating conditions for academic mobility of doctoral students;

− ensuring the functioning of the unified educational space of Kazakhstan;

− ensuring the recognition of the documents of the Republic of Kazakhstan on the award of the degree of doctor PhD or doctor in the profile in the international educational space and in the international labor market.

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

Persons who have mastered the educational program of doctoral studies and defended a doctoral dissertation, with a positive decision of the dissertation councils of a university with a special status or the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, according to the results of the examination, are awarded the degree of Doctor of Philosophy PhD or doctor in profile and a state-issued diploma with an appendix (transcript).

Persons who have received a PhD degree, in order to deepen scientific knowledge, solve scientific and applied problems on a specialized topic, perform a postdoctoral program or conduct scientific research under the guidance of a leading scientist of the chosen university.

**Requirements for the key competencies of doctoral graduates:**

*1) Have an idea:*

– about the main stages of development and paradigm shift in the evolution of science;

– on the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences;

– about scientific schools of the relevant branch of knowledge, their theoretical and practical developments;

– about scientific concepts of world and Kazakh science in the relevant field;

– on the mechanism of implementation of scientific developments in practical activities;

– on the norms of interaction in the scientific community;

– about the pedagogical and scientific ethics of a research scientist;

*2) Know and understand:*

– current trends, trends and patterns of development of Russian science in the context of globalization and internationalization;

– methodology of scientific knowledge;

– achievements of world and Kazakh science in the relevant field;

– (realize and accept) the social responsibility of science and education; – perfect foreign language for scientific communication and international cooperation;

*3) Be able to:*

– to organize, plan and implement the process of scientific research;

– analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;

– analyze and process information from various sources;

– conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;

– generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;

– to choose and effectively use modern research methodology;

– plan and predict their further professional development;

*4) Have the skills:*

– critical analysis, evaluation and comparison of various scientific theories and ideas;

– analytical and experimental scientific activities;

– planning and forecasting of research results;

– public speaking and public speaking at international scientific forums, conferences and seminars;

– scientific writing and scientific communication;

– planning, coordination and implementation of scientific research processes;

– a systematic understanding of the field of study and demonstrate the quality and effectiveness of the selected scientific methods;

– participation in scientific events, fundamental scientific domestic and international projects;

– leadership management and team management;

– responsible and creative attitude to scientific and pedagogical activity;

– conducting patent search and experience in the transfer of scientific information using modern information and innovative technologies;

– protection of intellectual property rights to scientific discoveries and developments;

– free communication in a foreign language;

*5) Be competent:*

– in the field of scientific and scientific-pedagogical activity in the conditions of rapid updating and growth of information flows;

– in carrying out theoretical and experimental scientific research;

– in the formulation and solution of theoretical and applied problems in scientific research;

– to conduct a professional and comprehensive analysis of problems in the relevant field;

– in matters of interpersonal communication and human resource management; – in matters of university training of specialists;

– in the examination of scientific projects and research;

– in ensuring continuous professional growth.

**Requirements for the research and development of a student under the Doctor of Philosophy PhD program:**

1) compliance with the main problems of the educational program of the doctoral program on which the doctoral dissertation is being defended;

2) relevant and contains scientific novelty and practical significance;

3) based on modern theoretical, methodological and technological achievements of science and practice;

4) is based on modern methods of data processing and interpretation using computer technology;

5) performed using modern methods of scientific research;

6) contains research (methodological, practical) sections on the main protected provisions.

**Requirements for the organization of practices:**

The practice is conducted with the aim of developing practical skills in scientific, scientific, pedagogical and professional activities.

The educational program of the doctoral program:

1) pedagogical and research practice – for students of the PhD program;

2) industrial practice – for students of the specialized doctoral program.

During the period of pedagogical practice, doctoral students, if necessary, are involved in conducting undergraduate and graduate studies. The duration of teaching practice for 1 credit is 1 week.

The doctoral student's research practice is conducted with the aim of studying the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as consolidating practical skills, applying modern research methods, processing and interpreting experimental data in dissertation research.

The content of the research practice is determined by the topic of the doctoral thesis.

# 4. Passport of educational program

## **4.1.** General information

| № | Field name | Comments |
|---|---|---|
| 1 | Code and classification of the field of education | 8D07 «Engineering, manufacturing and civil engineering» |
| 2 | Code and classification of training directions | 8D073 «Architecture and civil engineering» |
| 3 | Educational program group | D127 «Engineering systems and networks» |
| 4 | Educational program name | 8D07304 «Engineering systems and networks» |
| 5 | Short description of educational program | The innovative educational program provides training of scientific personnel focused on scientific, experimental research, pedagogical activities in the field of design of heat and gas supply, ventilation, water supply, sewerage, water supply and sanitation systems of settlements, industrial enterprises, water management and hydropower systems. The graduate is awarded the academic degree of Doctor of PhD.<br>Doctoral students study the creation of new technologies in the field of heat and gas supply, ventilation, water supply, sewerage, hydraulic engineering and hydropower facilities.<br>Much attention is paid to intellectual entrepreneurship, the development of applied projects for the real sector of the economy and the commercialization of launched projects.<br>Doctoral students actively participate in research projects under the guidance of foreign consultants.<br>Doctoral study plans include mandatory internships at leading foreign universities.<br>Preparation and defense of the dissertation are conducted under the supervision of 2 scientific supervisors, domestic and foreign. |
| 6 | Purpose of EP | The purpose of the educational program is to train highly qualified specialists with basic competencies in the field of solving organizational and production tasks in the implementation of innovative, research projects, the formation of personnel in the field of engineering systems and networks, covering modern energy and resource-saving technologies. |
| 7 | Type of EP | New |
| 8 | The level based on NQF | 8 |
| 9 | The level based on IQF | 8 |
| 10 | Distinctive features of EP | No |
| 11 | List of competencies of educational program | Universal, social and ethical competencies;<br>Special and managerial competencies;<br>Professional competencies. |
| 12 | Learning outcomes of educational | LO1 – Conduct an independent scientific study, |

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|---|---|---|
| | program | characterized by academic integrity, based on modern theories and methods of analysis.<br>LO2 – Generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge.<br>LO3 – To study the achievements of world and Kazakh science in the relevant field.<br>LO4 – Know the methodology of scientific knowledge. LO5 – Analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions.<br>LO6 – Choose and effectively use modern research methodology.<br>LO7 – Analyze and process information from various sources.<br>LO8 – Plan and predict their further professional development.<br>LO9 – To know the current trends, trends and patterns of development of Russian science in the context of globalization and internationalization.<br>LO10 – To organize, plan and implement the research process.<br>LO11 – Possess skills in economic justification and resolution of issues related to the design, operation and maintenance of engineering systems and networks, be able to analyze the results of studies of the technical condition of objects and carry out scientific and methodological work. |
| 13 | Education form | Full - time |
| 14 | Period of training | 3 |
| 15 | Amount of credits | 180 |
| 16 | Languages of instruction | Kazakh, russian, english |
| 17 | Academic degree awarded | Doctor of Philosophy PhD |
| 18 | Developer(s) and authors | Alimova K.K., Berdali M.N., Aliyakbarova U.H. |

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

| № | Discipline name | Short description of discipline | Amount of credits | Generated learning outcomes (codes) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | LO1 | LO2 | LO3 | LO4 | LO5 | LO6 | LO7 | LO8 | LO9 | LO10 | LO11 |
| **Cycle of basic disciplines**<br>**University component** | | | | | | | | | | | | | | |
| 1 | Methods of scientific research | Purpose: It consists in mastering knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry. Contents: structure of technical sciences, application of general scientific, philosophical and special methods of scientific research, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice. | **5** | | | v | v | v | | v | | | v | |
| 2 | Academic writing | Objective: to develop academic writing skills and writing strategies for doctoral students in engineering and natural sciences. Content: fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, and references; in-text citation; preventing plagiarism; and preparing a conference presentation. | **5** | | | v | v | | | v | | v | | |
| 3 | Pedagogical practice | The purpose of the pedagogical practice of doctoral students is to study the basics of pedagogical and scientific-methodical work in higher educational | **10** | v | | v | | | v | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | institutions, mastering pedagogical skills of conducting various types of training sessions and preparing teaching materials in fixed disciplines, strengthening motivation for pedagogical work in higher education. | | | | | | | | | | | | |
| **Cycle of basic disciplines Component of choice** | | | | | | | | | | | | | | |
| 4 | Modern water supply and sewage systems | Purpose: formation of theoretical foundations for the study of modern technologies for water purification and transportation in water supply and sewerage systems Contents: regulatory documentation for the design of water supply and sewerage systems; modern designs of water intake and treatment facilities; use of modern technological equipment in systems; design of structures in difficult climatic conditions; determination of economic indicators of projects in water supply and sewerage systems. | **5** | | | **v** | | **v** | | **v** | **v** | | | **v** |
| 5 | Modern gas supply systems of cities and industrial centers | Purpose: Formation of in-depth knowledge in the field of design and operation of modern gas supply systems Contents: general principles of design, installation and operation of gas supply systems in cities and industrial centers, selection of the distribution system, the number of hydraulic fracturing systems, hydraulic fracturing and the principle of construction of distribution gas pipelines, the main elements of industrial gas supply systems, structures on gas pipelines and means of protection against electrochemical corrosion. | **5** | **v** | **v** | | | | | **v** | **v** | | **v** | **v** |
| 6 | Intellectual property and the global market | Purpose: the goal is to train specialists in the field of intellectual property law who can analyze and predict trends in its development in the global market, develop strategies for the protection and | **5** | | | **v** | | | | **v** | | | **v** | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | commercialization of intellectual property. Contents: global aspects of intellectual property and its role in international trade and economics, analysis of international agreements and conventions, IP management strategies, cases of protection and violation of intellectual property rights in various jurisdictions. | | | | | | | | | | | | |
| **Cycle of profile disciplines<br>University component** | | | | | | | | | | | | | | |
| 7 | Theory and practice of designing modern engineering systems and networks | Purpose: Master theoretical and practical knowledge of designing modern systems and structures for populated areas. Contents: Design of modern engineering systems of buildings, modern equipment and calculations. Modern methods for designing urban water supply and sewerage networks. Structures on utility networks. Application of energy-saving equipment for water transportation. Specific water supply and sanitation systems for small settlements and rotational camps. | **5** | | | **v** | **v** | | **v** | | **v** | **v** | | **v** |
| 8 | Research practice | The doctoral student's research practice is conducted in order to study the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as to consolidate practical skills, apply modern research methods, process and interpret experimental data in a dissertation study. | **10** | | **v** | | | **v** | | **v** | | | | |
| **Cycle of profile disciplines<br>Component of choice** | | | | | | | | | | | | | | |
| 9 | Optimization of industrial wastewater | Gives an idea of the generalization of domestic and foreign experience in the treatment of industrial wastewater from toxic pollutants; analysis and optimization of MPC values of harmful substances | **5** | | | **v** | | **v** | | **v** | **v** | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | treatment systems | in wastewater; theoretical and experimental studies of the process of reagentless precipitation of heavy metal ions and the creation of a data bank on modern technologies for the treatment of industrial wastewater; development of a method for synthesizing technological chains of wastewater treatment; the creation of a rational scheme and the study of the effectiveness of treatment plants in radiator production. | | | | | | | | | | | | |
| 10 | Energy saving systems and equipment in buildings and structures | Purpose: to form theoretical knowledge and practical skills, as well as advanced technologies in the field of energy-saving systems and equipment of buildings and structures. Contents: theoretical foundations of energy saving, determination of energy efficiency indicators, reduction of consumption and efficient use of energy by systems and equipment. Energy inspection of systems and equipment, documentation, instrumentation and methodological support for energy surveys, accounting and control of consumed resources, economic and financial mechanisms of energy saving. Organization and stages of energy management. | **5** | | | **v** | | | **v** | | **v** | **v** | **v** | |