



**SATBAYEV
UNIVERSITY**

Institute Automation and information technology
Department Software Engineering

EDUCATIONAL PROGRAM
8D06101 «Software Engineering»
Code and name of educational program

Code and classification of the field of education: **8D06 "Information and communication technologies"**

Code and classification of training directions: **8D061 "Information and communication technologies"**

Group of educational programs: **D094 "Information technology"**

Level based on NQF: **8**

Level based on IQF: **8**

Study period: **3 года**

Amount of credits: **180**

Almaty 2024

Educational program 8D06101 «Software Engineering»
code and name of educational program

was approved at the meeting of K.I. Satbayev KazNRTU Academic Council





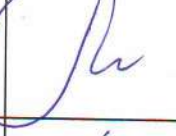
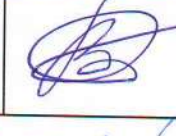

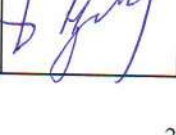
Minutes # 12 dated «22» 04 2024.

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

Minutes # 6 dated «19» 04 2024.

Educational program 8D06101 «Software Engineering»
code and name of educational program

was developed by Academic committee based on direction 8D061 «Information and
communication technologies»

| № | Full name | Academic degree/ academic title | Position | Workplace | Signature |
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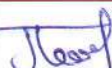


| | | | | | |
|--------------------------------|-------------------------------|-------------------|--|---|--|
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List of abbreviations and designations

EP – educational program

BC – basic competencies

PC – professional competencies

LO – learning outcomes

MOOC – Massive Open Online Courses

NQF – National Qualifications Framework

IQF – Industry Qualifications Framework

1. Description of educational program

The educational program 8D06101 «Software Engineering» aims to train a scholar capable of independently conducting scientific research, developing comprehensive software solutions, working in a team, and being well-versed in modern aspects of data science, with the achievement of the following competencies:

- Provide practice-oriented training for specialists in scientific activities and production in the field of software engineering;
- Prepare for career prospects in academic and research activities, as well as in the industry as specialists in the development of innovative software solutions;
- Create conditions for conducting original scientific research aimed at improving existing and creating new software solutions.

The EP is based on the state educational standard for higher professional education, the professional standard, and the Atlas of New Professions.

The content of the program's courses has been developed with consideration of corresponding educational programs from leading universities worldwide and the international classifier of professional activities in the field of information and communication technologies.

Graduates of the educational program 8D06101 «Software Engineering» are oriented towards the full cycle of software development, including design, coding, testing, and implementation, for all sectors of the economy, government organizations, and other areas of activity.

The educational program ensures the application of an individualized approach to students, transforming professional competencies from professional standards and qualification standards into learning outcomes. Student-centered learning is provided – a principle of education that shifts the focus in the educational process from teaching (as the primary role of the teaching staff in «transmitting» knowledge) to learning (as the active educational activity of the student).

The educational program was developed based on an analysis of the professional standards' labor functions, including professions such as ICT researcher and project manager in information technology.

Representatives of Kazakhstan companies and associations, specialists from departmental structures in the field of software engineering, scientific activities, and the development of innovative software solutions participated in the development of the educational program.

2. Purpose and objectives of educational program

Purpose of EP: The educational program aims to train scholars capable of independently conducting scientific research, developing comprehensive software solutions, working in a team, and navigating modern information technologies.

It focuses on preparing highly qualified specialists who can independently conduct scientific research, develop comprehensive software solutions, work effectively in teams, and confidently navigate the modern aspects of software

engineering. The program is designed to equip graduates with the competencies necessary for practice-oriented work in the development of innovative software solutions, as well as for conducting original scientific research and implementing innovative solutions in various industries.

Tasks of EP:

- Providing doctoral students with practical skills and knowledge necessary for work in the field of software development and systems engineering.
- Developing the ability to apply theoretical knowledge practically to solve real-world problems in software engineering.
- Creating conditions for conducting original scientific research in the field of software development.
- Facilitating the publication of research results in international and domestic peer-reviewed journals.
- Teaching doctoral students research methods and scientific analysis in software engineering.
- Developing skills in developing and implementing efficient software systems to solve practical problems.
- Teaching doctoral students to create and optimize software for various applications and industries.
- Preparing doctoral students for the development and implementation of complex software systems and infrastructures.
- Training in the use of modern tools and technologies used in software development.
- Developing skills to work in interdisciplinary teams and effectively collaborate with other specialists.
- Teaching communication skills and presenting the results of one's work.
- Supporting continuous self-education and professional development of doctoral students.
- Developing critical thinking and the ability for independent learning.
- Cultivating a sense of responsibility and ethics in software development among doctoral students.
- Ensuring understanding of the social, economic, and environmental aspects of software development and usage.

The educational program 8D06101 «Software Engineering» is implemented according to the credit-based learning technology and is conducted in both state and Russian languages.

The educational program aims to implement the principles of the Bologna Process. Based on students' choice and independent planning of the sequence of disciplines, they autonomously create an individual study plan (ISP) for each semester according to the Work Study Plan and the Catalog of Elective Disciplines. The program includes an increased volume of mathematical, natural sciences, basic, and language disciplines.

Disciplines studied include Foundations of Software Engineering, Big Data Storage Systems And Computations, Sustainability Science, Predictive Analytics

and Data Mining, High Load Distributed Computing, Software Architecture & Design, Software DevSecOps, Research methodology, Academic Writing and others.

Doctoral students undergo scientific research internships in banking institutions, government agencies, and corporate structures such as JSC «Institute of Digital Equipment and Technologies», Republican State Enterprise on the right of economic management «Institute of Information and Computing Technologies» of the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan, JSC «Kaspi Bank», JSC «Halyk Bank», JSC «Centrkredit Bank», among others. They also participate in international internships at leading foreign universities focused on scientific research. Additionally, doctoral students undergo pedagogical practice at domestic universities.

3. Requirements for the evaluation of educational program learning outcomes

The educational program is developed in accordance with the State Mandatory Standards of Higher and Postgraduate Education, approved by the order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022, №2 (registered in the Register of Regulatory Legal Acts under №28916). It reflects the learning outcomes based on which study plans (work study plans, individual study plans of students) and syllabi are developed for disciplines. At least 10% of the total credit volume of the educational program is covered through MOOCs on the official platform <https://polytechonline.kz/cabinet/login/index.php/> and also by studying disciplines via the international educational platform Coursera <https://www.coursera.org/>.

Assessment of learning outcomes is conducted through developed assignments within the educational program in accordance with the requirements of the State Mandatory Standards of Higher and Postgraduate Education.

During the assessment of learning outcomes, equal conditions and opportunities are provided for students to demonstrate their levels of knowledge, skills and abilities.

Online proctoring is utilized for intermediate assessment conducted in an online format.

4. Passport of educational program

4.1. General information

| № | Field name | Comments |
|----------|---|--|
| 1 | Code and classification of the field of education | 8D06 «Information and communication technologies» |
| 2 | Code and classification of | 8D061 «Information and communication technologies» |

| | | |
|----|---|---|
| | training directions | |
| 3 | Educational program group | D094 «Information technologies» |
| 4 | Educational program name | program 8D06101 «Software Engineering» |
| 5 | Short description of educational program | Ensure practice-oriented training for specialists in scientific research and production in the fields of data analysis, machine learning, and artificial intelligence. Prepare them for career opportunities in academic and research activities, as well as in the industry, as data analysts, software developers, machine learning engineers, and AI researchers. Create conditions for conducting original scientific research in machine learning and data science, publishing research results in international and domestic peer-reviewed journals, developing and implementing machine learning algorithms to solve practical problems, and designing comprehensive software systems for big data analysis. |
| 6 | Purpose of EP | The aim of the educational program is to train scientists capable of independently conducting research, developing comprehensive software solutions, working in teams, and navigating modern information 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 | <p>BC:</p> <ul style="list-style-type: none"> - Develop practical skills and knowledge necessary for working in data analysis, machine learning, and artificial intelligence. - Study methods of conducting research and scientific analysis. - Build skills in developing and implementing effective machine learning algorithms to solve practical problems. - Design algorithms for various applications and industries. <p>PC:</p> <ul style="list-style-type: none"> - Conduct original scientific research in the fields of machine learning and data science. - Publish research results in international and domestic peer-reviewed journals. - Plan and execute tasks related to the development and implementation of effective machine learning algorithms to solve practical problems. |
| 12 | Learning outcomes of educational program | <p>LO1: Apply the methodology of scientific knowledge, the principles and structure of scientific research, use experimental and theoretical research methods in the field of software development.</p> <p>LO2: Apply methods of predictive analytics and data mining in various areas of professional activity.</p> <p>LO3: Choose methods and develop algorithms for solving problems of managing complex and distributed infrastructures of large enterprises and technological complexes.</p> |

| | | |
|----|--------------------------|---|
| | | <p>LO4: Apply machine learning methods in relation to big data processing tasks, conduct scientific research, organize work on collecting, storing and processing information.</p> <p>LO5: Create analytical systems and recommendation services based on machine learning and deep learning algorithms.</p> <p>LO6: Describe pilot projects using blockchain technology based on the principles of building blockchain applications, the necessary infrastructure and legal framework for the implementation of blockchain technology.</p> <p>LO7: Conduct a stylistic analysis of scientific, scientific, technical and popular science texts, apply the methodology of working with text, including searching for information in reference, specialized literature and computer networks, use the skills of oratory, the correct and logical formulation of one's thoughts in oral and written form.</p> <p>LO8: Design the architecture of computing systems and choose the types of computers, operating systems, programming languages, programming technologies, database models for solving problems in various areas of professional activity.</p> <p>LO9: Apply server design techniques used in object-oriented distributed systems.</p> <p>LO10: Apply different kinds of models used in software development and describe the relationship between models and software development.</p> |
| 13 | Education form | Daytime, online |
| 14 | Period of training | 3 years |
| 15 | Amount of credits | 180 |
| 16 | Languages of instruction | Kazakh, Russian |
| 17 | Academic degree awarded | Doctor of Philosophy (PhD) upon successful defense of the doctoral dissertation |
| 18 | Developer(s) and authors | Abdoldina F.N., Moldagulova A.N., Mukhamediev R.I., Mukazhanov N.K. |

Professional Standard for the EP

| № | Name of professional standard | Date of approval of the PS |
|---|---|----------------------------|
| 1 | Teacher (faculty) of higher and (or) postgraduate education organizations | 20.11.2023 |
| 2 | Software testing | 05.12.2022 |
| 3 | Creation and management of information technologies | 24.12.2019 |

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 | The formed educational outcomes (code) | | | | | | | | | |
|--|----------------------|--|-------------------|--|-----|-----|-----|-----|-----|-----|-----|-----|------|
| | | | | LO1 | LO2 | LO3 | LO4 | LO5 | LO6 | LO7 | LO8 | LO9 | LO10 |
| Cycle of basic disciplines University component | | | | | | | | | | | | | |
| 1 | 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 | | | | | | | | | |
| 2 | Research methodology | Objective: to acquire knowledge about the laws, principles, concepts, terminology, content, and specific features of organizing and managing scientific research using modern scientometric methods. Content: the structure of technical sciences, the application of general scientific, philosophical, and specialized methods of scientific research, principles of organizing scientific research, methodological features of modern science, ways of developing science and scientific research, the role of technical sciences, informatics, and | 5 | v | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|--|---|--|--|--|--|--|---|
| | | engineering research in theory and practice. | | | | | | | | | | | |
| Cycle of basic disciplines Component of choice | | | | | | | | | | | | | |
| 3 | Sustainability Science | Objective: to develop a deep understanding among doctoral students of the interactions between natural and social systems, as well as to develop skills for identifying and developing strategies for sustainable development that promote long-term human well-being and environmental preservation. Content: complex interconnections between ecosystems and societies, as well as an in-depth analysis of sustainability issues at local, national, and international levels. | 5 | v | v | | | | | | | | |
| 4 | Big Data Storage Systems And Computations | The course explores the theoretical foundations of big data and distributed computing, as well as technologies for building storage and processing systems for big data. It includes topics such as the study of network interaction protocols, defining asynchronous and synchronous operations, issues of memory fragmentation and virtual machine instruction execution, multithreaded programming, multiprocessor programming, problems of coherence and fault tolerance and their solutions, and network interaction issues. | 5 | | | | v | | | | | | |
| 5 | Foundations of Software Engineering | Purpose: to teach students the key principles and methods of software | 5 | v | | | | | | | | | v |

| | | | | | | | | | | | | | |
|---|--------------------------------------|---|---|--|---|--|---|---|--|---|---|--|---|
| | | development. Content: key principles and methods of software development, principles of collaboration, automation, measurement and iteration, as well as tools and practices such as containerization, orchestration and continuous integration and delivery, security aspects, integration of security into the development process at early stages of the lifecycle. | | | | | | | | | | | |
| Cycle of profile disciplines Component of choice | | | | | | | | | | | | | |
| 6 | Predictive Analytics and Data Mining | The course studies technologies that rely on large datasets to develop scenarios for future human behavior and make optimal decisions. It covers predictive analytics, which includes a variety of methods from statistics and data mining. To forecast future events, the course analyzes both current and historical data. It also examines models for predicting potential customer behavior and identifying the most popular products and services. | 5 | | v | | | v | | | v | | |
| 7 | High Load Distributed Computing | Purpose: to study the theoretical foundations of distributed computing systems. Contents: distributed RAM, distributed data stores. It covers the technologies and principles of grid and cloud computing, as well as provides a practical introduction to the grid middleware. The course also examines current research topics in the development and use of modern | 5 | | | | v | | | v | | | v |

| | | | | | | | | | | | | | |
|---|--------------------------------|---|---|--|---|---|--|--|--|--|---|--|---|
| | | systems for distributed computing, including the use of cloud resources for grid computing. | | | | | | | | | | | |
| 8 | Software Architecture & Design | Purpose: To provide in-depth knowledge of architectural approaches in software development, including client-server architecture, microservices, event architecture and others. Content: analysis of basic design patterns such as MVC (Model-View-Controller), MVVM (Model-View-ViewModel), and various application state management strategies, principles for creating extensible, flexible and scalable architectural solutions, as well as methods for ensuring high performance and security of software systems. | 5 | | v | v | | | | | v | | v |
| 9 | Software DevSecOps | Purpose: To teach the key principles and methods of DevSecOps, focused on integrating development, operations and security into a single software development process. Contents: an introduction to the key principles and methods of DevSecOps, focused on combining development, operations and security into a single software development process, principles of collaboration, automation, containerization, orchestration and continuous integration and delivery, as well as security aspects in DevOps. | 5 | | | v | | | | | | | |

5. Curriculum of educational program



KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATBAYEV



CURRICULUM
of Educational Program on enrollment for 2024-2025 academic year

Educational program 8D06101 - "Software Engineering"
Group of educational programs 8D094 - "Information technologies"

Form of study: full-time

Duration of study: 3 year

Academic degree: Doctor of Philosophy PhD

| Discipline code | Name of disciplines | Cycle | Total amount in credits | Total hours | Classroom amount lec/lab/pr | SIS (including TSIS) in hours | Form of control | Allocation of face-to-face training based on courses and | | | | | |
|---|--|---------|-------------------------|-------------|-----------------------------|-------------------------------|-----------------|--|------------|------------|------------|------------|------------|
| | | | | | | | | 1 course | | | 2 course | | |
| | | | | | | | | 1 semester | 2 semester | 3 semester | 4 semester | 5 semester | 6 semester |
| CYCLE OF BASIC DISCIPLINES (BD) | | | | | | | | | | | | | |
| M-1. Module of basic training (university component) | | | | | | | | | | | | | |
| CSE339 | Scientific research methods | BD UC | 5 | 150 | 2/0/1 | 105 | E | 5 | | | | | |
| LNG305 | Academic writing | BD UC | 5 | 150 | 0/0/3 | 105 | E | 5 | | | | | |
| component of choice | | | | | | | | | | | | | |
| CSE344 | Foundations of Software Engineering | BD CCH | 5 | 150 | 2/0/1 | 105 | E | 5 | | | | | |
| CSE306 | Big Data Storage Systems And Computations | | | | | | | | | | | | |
| MNG350 | Sustainability Science | | | | | | | | | | | | |
| CYCLE OF PROFILE DISCIPLINES (PD) | | | | | | | | | | | | | |
| M-2. Module of professional activity (component of choice) | | | | | | | | | | | | | |
| CSE343 | Software DevSecOps | PD, CCH | 5 | 150 | 2/0/1 | 105 | Э | 5 | | | | | |
| CSE307 | High Load Distributed Computing | | | | | | | | | | | | |
| CSE345 | Software Architecture & Design | PD, CCH | 5 | 150 | 2/0/1 | 105 | Э | 5 | | | | | |
| CSE327 | Predictive Analytics and Data Mining | | | | | | | | | | | | |
| M-3. Practice-oriented module | | | | | | | | | | | | | |
| AAP350 | Pedagogical practice | BD UC | 10 | | | | | | | 10 | | | |
| AAP355 | Research practice | PD UC | 10 | | | | | | | | 10 | | |
| M-4. Experimental research module | | | | | | | | | | | | | |
| AAP336 | Research work of a doctoral candidate, including internships and completion of a doctoral dissertation | RWDS UC | 5 | | | | | | 5 | | | | |
| AAP347 | Research work of a doctoral candidate, including internships and completion of a doctoral dissertation | RWDS UC | 40 | | | | | | | 20 | 20 | | |
| AAP356 | Research work of a doctoral candidate, including internships and completion of a doctoral dissertation | RWDS UC | 60 | | | | | | | | | 30 | 30 |
| AAP348 | Research work of a doctoral candidate, including internships and completion of a doctoral dissertation | RWDS UC | 18 | | | | | | | | | | 18 |
| M-5. Module of final attestation | | | | | | | | | | | | | |
| ECA303 | Writing and defending a doctoral dissertation | FA | 12 | | | | | | | | | | 12 |
| Total based on UNIVERSITY: | | | | | | | | 30 | 30 | 30 | 30 | 30 | 30 |
| | | | | | | | | 60 | 60 | 60 | 60 | 60 | |

| Number of credits for the entire period of study | | | | | |
|--|--|---------------------------|---------------------------|-----------|------------|
| Cycle code | Cycles of disciplines | Credits | | | Total |
| | | university component (UC) | component of choice (CCH) | | |
| BD | Cycle of basic disciplines | 20 | 5 | | 25 |
| PD | Cycle of profile disciplines | 10 | 10 | | 20 |
| | Total for theoretical training: | 0 | 30 | 15 | 45 |
| | RWDS | | | | 123 |
| FA | Final attestation | 12 | | | 12 |
| | TOTAL: | 12 | 30 | 15 | 180 |

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № 12 or "22" 04 2024 y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 6 or "19" 04 2024 y.

Decision of the Academic Council of the Institute of Automation and Information Technology. Protocol № 8 or "29" 01 2024 y.

Vice-Rector for Academic Affairs

Acting Director of the Institute of A&IT

Head of the Department of Software Engineering

Specialty Council representative from employers, President of the Association of Innovative Companies of the SEZ "PIT", Ph.D.

Uskenbayeva R.K.

Kalpeeva Zh.B.

Abdoldina F.N.

Konybayev A.T.