NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY
named after K.I.SATBAYEV»

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
Chairperson of Academic Committee:					
1	Abdoldina Farida Nauruzbaevna	Candidate of Technical Sciences	Head of Department, Associate Professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 707 820 6525	
Teaching staff:					
2	Mukhamediev Ravil Ilgizovich	Candidate of Technical Sciences	Professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 777 241 8672	
3	Moldagulova Ayman Nikolaevna	Candidate of Physical and Mathematical Sciences	Professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 701 727 9025	
4	Mukajanov Nurzhan Kakenovich	PhD	Associate professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 775 724 8242	
5	Gertsen Yevgeniy Alexandrovich	Master of Science	Senior teacher	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 777 209 4343	
6	Baimbetov Daulet Abibullaevich	Master of Science	Senior teacher	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 707 891 4322	
	Employers:				
7	Konysbaev Amiret Tuyakuly	Candidate of Philosophical Sciences	President of the Association	Association of Innovative Companies FEZ "PIT", mob. phone: +7 708 106 5028	
8	Nurseitov Daniyar Borisovich	Candidate of Physical and Mathematical	Expert (disciplinary)	BigDATA sector, KMG engineering LLP, mob. phone: +7 777 127 7711	

		Sciences			
9	Akylaev Zhasulan Akzholovich	Master of Science	Head of Department	Transactional systems testing department Transactional systems department of JSC Halyk Bank of Kazakhstan, mobile. phone: +7 771 701 2811	
Alumni Representatives:					
10	Mereke Askhat Asylbekuly	Master of Science	Lead programmer 1st category (senior full-stack)	"The Boss media group" LLP, mob. phone: +7 707 426 0165	
11	Dzhamalov Jalal Kudratovich	PhD	Team Lead	JSC Kaspi Bank, Kaspi Pay transfer development team, mobile. phone: +7 701 949 7935	
Receiving education:					
12	Rystygulov Panabek Abashovich	Master of Science	Doctoral student, 1st year	mobile. phone: +7 775 202 4224	
13	Mukin Dmitry Mikhailovich	Bachelor	Master's student, 1st year	mobile. phone: +7 707 157 5233	
14	Halmatai Nurbek Kasymuly	-	Student, 3rd year	mobile. phone: +7 700 484 4808	

Table of contents

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	BC: - 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. PC: - 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	**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. **LO2**: Apply methods of predictive analytics and data mining in various areas of professional activity. **LO3:** Choose methods and develop algorithms for solving problems of managing complex and distributed infrastructures of large enterprises and technological complexes.

		LO4: Apply machine learning methods in relation to big data processing tasks, conduct scientific research, organize work on collecting, storing and processing information. **LO5:** Create analytical systems and recommendation services based on machine learning and deep learning algorithms. **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. **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. **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. **LO9:** Apply server design techniques used in object-oriented distributed systems. **LO10:** Apply different kinds of models used in software development and describe the relationship between models and software development.
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.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kazgtu named after K.Satpayev
M.M.Beisenbaev
2024 y.

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					
								I 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				1/1/1								
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	

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
			university component (UC)	component of choice (CCH)	Total
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 № 2 **от "** 22 **"** 04 **20** 24 **y.**

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 6 **от "** 19 **"** 04 **20** 24 **y.**

Decision of the Academic Council of the Institute of Automation and Information Technology. Protocol № 8 **от "** 29 **"** 01 **20** 24 **y.**

Vice-Rector for Academic Affairs — **Uskenbayeva R.K.**

Acting Director of the Institute of A&IT — **Kalpeeva Zh.B.**

Head of the Department of Software Engineering — **Abdoldina F.N.**

Specialty Council representative from employers, President of the Association of Innovative Companies of the SEZ "PIT", Ph.D. — **Konysbayev A.T.**