Kazakh National Research Technical University named after K.I. Satpayev

Institute of Automation and Information Technology
Department of Cybersecurity, Information Processing and Storage

EDUCATIONAL PROGRAM
8D06301 - "Information security systems"
Doctor of Philosophy (PhD)
in the field of Information and Communication Technologies

Code and classification of the field of education:
8D06 - Information and communication technologies
Code and classification of training areas:
8D063 Information security Group of educational programs:
D095 Information Security
NRK Level: 8
ORC Level: 8
Duration of study: 3 years
Volume of credits: 180

Almaty, 2025

K.I. SATPAYEV KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY, NON-PROFIT JOINT STOCK COMPANY

The educational program 8D06301 - "Information security systems" was approved at a meeting of the Academic Council of K.I.Satpayev KazNTU.
Protocol no.№10_ from "_06__" __03__ 2025 .
Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of K.I.Satpayev Kazntu.
Protocol no.№ _3_ from "_20__" __12__2024.

The educational program "8D06301-Information security systems" was developed by the academic committee in the direction of D095 – "Information Security"

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Table of contents

1. Description of the educational program

The educational program for the preparation of a doctor of Philosophy (PhD) has a scientific and pedagogical orientation and assumes fundamental educational, methodological and research training and in-depth study of disciplines in relevant fields of sciences for the system of higher and postgraduate education and the scientific sphere. The direction of the educational program relates to information and communication technologies. The professional activities of graduates of the program cover the field of information protection and security, information security systems and cybersecurity.

The doctoral educational program in terms of professional training has been developed based on the study of the experience of foreign universities and research centers that implement accredited PhD training programs.

The main criterion for the completion of the educational process for the preparation of doctors of philosophy (PhD) is the acquisition by a doctoral student of at least 180 academic credits, including all types of educational and scientific activities.

The duration of doctoral studies is determined by the amount of academic credits acquired. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a Doctor of Philosophy (PhD) degree, the doctoral program is considered fully completed.

Persons who have completed the doctoral program and defended their doctoral thesis, upon a positive decision of the dissertation councils of universities with a special status or the Committee for Control in the Field of Education and Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan, based on the results of the examination, are awarded the degree of Doctor of Philosophy (PhD) and a state-issued diploma with an appendix (transcript).

Doctoral training is carried out on the basis of master's degree programs in the scientific and pedagogical field with a period of study of at least three years. The doctoral program accepts persons with a Master's degree and at least 1 (one) year of work experience.

Admission to the number of doctoral students is carried out by the admission committees of universities and scientific organizations based on the results of the entrance exam for groups of doctoral educational programs and a certificate confirming proficiency in a foreign language in accordance with the pan-European competencies (standards) of foreign language proficiency.

When enrolling in universities, doctoral students independently choose an educational program from the corresponding group of educational programs.

The enrollment of persons for the targeted training of doctors of philosophy (PhD) under the state educational order is carried out on a competitive basis.

The procedure for admission of citizens to doctoral studies is established in accordance with the "Standard Rules for admission to study in educational organizations that implement educational programs of postgraduate education."

The formation of a contingent of doctoral students is carried out through the placement of a state educational order for the training of scientific and pedagogical personnel, as well as tuition fees at the expense of citizens' own funds and other sources. The State provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive this level of education for the first time.

At the "entrance", the doctoral student must have all the prerequisites necessary to master the relevant professional doctoral training program. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the doctoral student is allowed to master them on a fee basis. In this case, doctoral studies begin after the doctoral student has fully mastered the prerequisites.

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

1. The purpose and objectives of the educational program

Purpose of the OP: The purpose of the educational program is to provide comprehensive and high-quality training for competitive, highly qualified specialists in the field of information protection and security, who are ready to solve scientific, practical and theoretical tasks of professional activity in modern conditions.

The global goal of the Information Security Systems educational program is to contribute to the achievement of the Sustainable Development Goals (SDGs):

- Goal 4: Quality education (Ensuring inclusive and equitable quality education and encouraging lifelong learning opportunities for all);
- Goal 8: Decent work and economic growth (Promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all);
- Goal 9: Industrialization, Innovation and Infrastructure (Building resilient infrastructure, promoting inclusive and sustainable industrialization and innovation);
- Goal 11: Sustainable cities and human settlements (Ensuring openness, security, resilience and environmental sustainability of cities and human settlements); -

Goal 16: Peace, Justice and effective institutions (Promoting a peaceful and inclusive society for sustainable development, ensuring access to justice for all, and creating effective, accountable, and participatory institutions at all levels).

OP tasks:

Training of highly qualified specialists who are able to solve the following tasks:

- to organize, plan and implement the scientific research process;
- analyze, evaluate and compare various theoretical concepts in the field of information security systems research and draw the necessary conclusions;
- analyze and process information from different sources;
- to conduct independent scientific research that characterizes academic integrity based on modern theories and methods of analysis;
- generate your own new scientific ideas;
- bring your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- choose and effectively use a modern research methodology;
- plan and predict their further professional development;
- to analyze, formulate problem statements, develop mathematical models, conduct modeling to study the functioning of information security systems using modern technologies;
- conduct information security analysis and audit;
- identify system vulnerabilities and ensure system protection in a timely manner;
- to develop and research models and methods of information security management;
- apply technical means of countering espionage to ensure and evaluate information security;
- to organize the protection and security of information in database management systems;
- to analyze and synthesize modern cryptographic tools;
- apply information protection methods in network technologies;
- formulate, investigate and solve information security problems using modern research methods;
- to develop, research and apply modern technologies in the field of information security;
- to teach in higher educational institutions, to apply innovative methods in practice.

The main functions of doctoral students' professional activities are: conducting research in the field of information protection and security; auditing, vulnerability analysis and incident investigation in information security systems; design, implementation, operation, administration, maintenance and testing of information security systems of enterprises.

The areas of professional activity are as follows:

-design, development, implementation and operation of information security systems;

− analysis, testing and identification of system vulnerabilities;

− information security audit.

The objects of professional activity of graduates of doctoral programs in the educational program "Information Security systems" are:

− Public administration bodies;
− information security departments and departments of departmental organizations;
− information security departments, IT departments and departments of financial organizations;
− information security departments, IT departments and departments of industrial enterprises;
− higher education institutions and scientific institutions;
− departments and departments of information security of government organizations and commercial structures.

The areas of professional activity are as follows:

− organizational and managerial;
− design and engineering;
− production and technological;
− scientific research;
− pedagogical.

The objects of professional activity of graduates are:

- all areas of the Republic of Kazakhstan where it is necessary to ensure information security;
- comprehensive information security support for industrial enterprises;
- research and development work in higher educational institutions and scientific institutions;
- information security systems of government agencies;
- academic institutions.

3. Requirements for the assessment of learning outcomes of the educational program

The requirements for the doctoral candidate's level of training are determined on the basis of the Dublin Descriptors of the third level of Higher education (doctoral studies) and reflect the acquired competencies expressed in the achieved learning outcomes. Learning outcomes are formulated both at the level of the entire doctoral program and at the level of a particular academic discipline.

A graduate who has completed a doctoral program must have the following general professional competencies:

1) demonstrate a systematic understanding of the field of study, mastery of the skills and research methods used in this field;

2) demonstrate the ability to think, design, implement and adapt an essential research process with a scientific approach;

3) to contribute with their own original research to the expansion of the boundaries of the scientific field, which deserves publication at the national or international level;

4) critically analyze, evaluate and synthesize new and complex ideas;

5) communicate their knowledge and achievements to colleagues, the scientific community and the general public;

6) to promote knowledge-based technological, social or cultural development of society in the academic and professional context.

A PhD in information security should have professional competencies corresponding to the types of professional activities that the doctoral program is focused on:

organizational and managerial activities:

- be the head of the information security department, department, department; design and engineering activities:

- be the head of the department for the development, design, and implementation of information security systems in various industries;

- be a leading designer for the development, design, and implementation of information security systems in various industries;

production and technological activities:

- be a leading analyst in identifying, evaluating vulnerabilities, and investigating incidents;
- be the head of an audit team or an auditor when conducting an audit of information security systems;

scientific research activities:

- to be the head of a scientific laboratory for conducting theoretical and experimental research in the field of information security;
- be a leading researcher or head of a scientific laboratory for the research and development of modern information security systems;

teaching activities:

- to be a teacher of bachelor's, master's and doctoral studies in basic and specialized disciplines in the field of information security and protection;

Research requirements for a student in the Doctor of Philosophy (PhD) program:

1) compliance with the main issues of the educational program of the doctoral program, according to which the doctoral thesis is being defended;

2) relevant and contains scientific novelty and practical significance;

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

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

5) performed using modern scientific research methods; 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 PhD educational program includes teaching and research practice.

During the period of pedagogical practice, doctoral students, if necessary, are involved in conducting undergraduate and graduate studies.

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 internship of a doctoral student is conducted in order to consolidate the theoretical knowledge gained during the training process and improve the professional level.

The content of the internship and research practice is determined by the topic of the doctoral thesis. Scientific internships are provided during the training: University of Ottawa, Canada; National Aviation University, Kiev, Ukraine; Faculty of Engineering, University Putra Malasia.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	8D06 - Information and communication technologies
2	The code and classification of training areas	8D063 - Information security
3	Group of educational programs	D095 - Information security
4	Name of the educational program	8D06301 - Information security systems
5	Brief description of the educational program	Graduates' professional activities include: science, education, government and departmental structures,

		public administration and local government, economics and finance, industry, agriculture, culture, and healthcare. The objects of professional activity of graduates of master's degree programs in the educational program "Integrated information Security" are: − Public administration bodies; − information security departments and departments of departmental organizations; − information security departments, IT departments and departments of financial organizations; − information security departments, IT departments and departments of industrial enterprises; − higher education institutions and scientific institutions; − departments and departments of information security of government organizations and commercial structures. The main functions of doctoral students' professional activities are: conducting research in the field of information protection and security; auditing, vulnerability analysis and incident investigation in information security systems; design, implementation, operation, administration, maintenance and testing of information security systems of enterprises. providing hardware and software protection of information systems for various purposes The areas of professional activity are as follows: − design, development, implementation and operation of information security systems; − analysis, testing and identification of system vulnerabilities; − information security audit.
6	Purpose of the OP:	The purpose of the educational program is to provide comprehensive and high-quality training for competitive, highly qualified specialists in the field of information protection and security, who are ready to solve scientific, practical and theoretical tasks of professional activity in modern conditions. The global goal of the Information Security Systems educational program is to contribute to the achievement of the Sustainable Development Goals (SDGs).
7	Type of OP	Updated OP
8	The NRK level	8
9	ORC Level	8
10	Distinctive features of the OP	The program is aimed at training professional specialists in the field of information security system management. Unlike existing educational programs in the field of information security, it is planned to actively expand graduate training towards the use of international practices and standards of information security, which will provide him with advanced training..
11	List of educational program competencies:	Requirements for the key competencies of graduates of the educational institution "Information Security

		Systems". The graduate must: **1) have an idea of:** - modern methods of building and developing information security systems from the point of view of current trends, trends and patterns of development of domestic and foreign science in the context of globalization and internationalization; - about modern software tools for research, modeling and design of information security systems; - about modern technical tools used to analyze and identify system vulnerabilities; - about the main stages of development and paradigm shift in scientific knowledge; - about the subject, methodological specifics of the field of information security; - about scientific schools in the field of information security, their theoretical and practical developments; - about scientific concepts of world and Kazakh science in the field of information protection and security; - organization of information protection and security in database management systems; - about modern cryptosystem tools; - information security methods in network technologies; - about the use of blockchain technology to ensure information security; - on the study of information security problems using modern research methods; - about teaching in higher education institutions, the application of innovative methods in practice. **2) know:** - current trends, trends and patterns of development of Russian science in the field of information protection and security in the context of globalization and internationalization; - methodology of scientific knowledge in the field of information security; - achievements of world and Kazakh science in the field of information protection and security; - modern methods of building and analyzing the functioning of information security systems in various industries; - standards, methodological and regulatory materials accompanying research, design, testing, auditing and operation of information security systems in various industries; - current development trends, forecast estimates of the use of technical means in ensuring information security; - information security management methodology. - modern methods of organizing information protection and security in database management systems; - the trend of development of modern cryptosystem tools; - methods of big data analysis using modern technologies;

		- the methodology of teaching in higher education institutions and the application of modern teaching methods in practice. **3) be able to:** - to organize, plan and implement the scientific research process; - analyze, evaluate and compare various theoretical concepts in the field of information security systems research and draw the necessary conclusions; - analyze and process information from different sources; - to conduct independent scientific research that characterizes academic integrity based on modern theories and methods of analysis; - generate your own new scientific ideas; - bring your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge; - choose and effectively use a modern research methodology; - plan and predict their further professional development; - to analyze, formulate problem statements, develop mathematical models, conduct modeling to study the functioning of information security systems using modern technologies; - conduct information security analysis and audit; - identify system vulnerabilities and ensure system protection in a timely manner; - to develop and research models and methods of information security management; - apply technical means of countering espionage to ensure and evaluate information security; - to organize the protection and security of information in database management systems; - to analyze and synthesize modern cryptographic tools; - apply information protection methods in network technologies; - formulate, investigate and solve information security problems using modern research methods; - to develop, research and apply modern technologies in the field of information security; - to teach in higher educational institutions, to apply innovative methods in practice. **4) have the skills:** - critical analysis, evaluation and comparison of various scientific theories and ideas; - analytical and experimental research activities; - planning and forecasting of research results; - speaking and public speaking at international scientific meetings, conferences and seminars; - scientific writing and scientific communication; - planning, coordination and implementation of the research process; - a systematic understanding of the research area and

		demonstration of the effectiveness of selected qualitative and scientific methods; - organization of scientific research in the field of information security; - conducting an analysis, assessment and audit of information security. - organization of work on the collection, storage and processing of information used to ensure the protection and security of information; - building information security management models; - organization of system protection and information security in database management systems; - analysis and synthesis of modern cryptosystem tools; - application of information security methods in network technologies; - research and solutions to information security problems using modern research methods; - development, research and application of modern technologies in the field of information security; - teaching in higher education institutions, applying modern research methods in practice; - expanding and deepening the knowledge necessary for daily professional activities and continuing education in postdoctoral studies. **5) be competent:** – in the field of scientific research methodology; – in the field of scientific and scientific-pedagogical activity in higher educational institutions; – in matters of modern educational technologies; – in carrying out scientific projects and research in the professional field; – in the organization of information security systems; – in conducting an information security audit; – in ensuring the information security of the organization; – in ways to ensure continuous updating of knowledge, expansion of professional skills and abilities.
12	Learning outcomes of the educational program:	**PO1** Apply standards, methodological and regulatory materials for research, design, testing, auditing and operation of information security systems in various industries. **PO2** Apply blockchain technologies and modern technical means of countering espionage to ensure and evaluate information security. **PO3** Generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge in order to promote innovation. Choose and effectively use a modern research methodology. Speak foreign languages for partnership for sustainable development **PO4** Analyze, evaluate, and compare methods for organizing information protection and security in database management systems. The ability to organize

		information protection and security, apply modern technologies in solving information protection and security problems in database management systems, and use the results in their professional activities. **PO5** To systematize knowledge in the field of modern software tools for research, modeling and design of information security systems. To illustrate the research skills and methods used in the field of information security systems **PO6** To carry out an assessment and comparative analysis of various theoretical concepts in the field of information security systems research. **PO7** To identify current trends, trends and patterns in the development of domestic science in order to identify system vulnerabilities, timely ensure system protection, use technical means to counter espionage and assess sustainable information security.
13	The form of education	full-time
14	Duration of training	3 years
15	Volume of loans	180 credits
16	Languages of instruction	Kazakh, Russian,
17	Academic degree awarded	Doctor of Philosophy PhD
18	Developer(s) and authors:	Aitkhozhaeva E.Zh., Serbin V.V. Yubuzova Kh.I

4.2. The relationship between the achievability of the formed learning outcomes in the educational program and academic disciplines

№	Name of the discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)						
				PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	Scientific research methods	Purpose: to acquire knowledge about the laws, principles, concepts, terminology, content, and specific features of the organization and management of scientific research using modern methods of scientometry. Contents: the structure of technical sciences, the application of general scientific, philosophical and special methods of scientific research, the principles of scientific research organization, 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				
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, conclusion, used literary sources; quoting in the text; preventing plagiarism, as well as making a presentation at a conference.	5			v				
3	Information Security management Systems	Modern practice of applying models and methods of information security management, methodology of analysis and research of models and methods of information security management in practice and scientific research.	5		v		v	v		
4	Blockchain technologies and data security	The basic concepts and models of the blockchain are considered. The course examines the technical fundamentals of the blockchain, the processes of processing and protecting data in the blockchain system, regardless of the type of data. Transaction security in the	5		v				v	v

		blockchain.								
5	The science of sustainable development	Objective: to provide doctoral students with a deep understanding of the interactions between natural and social systems, as well as to develop skills in identifying and developing strategies for sustainable development that contribute to the long-term well-being of humanity and the preservation of the environment. Content: The complex interrelationships between ecosystems and societies, as well as delve into the analysis of sustainability issues at the local, national and international levels.	5	v						
6	Information protection in database management systems	Security threats. The database structure. Designing secure databases. Normalization of relations. Data integrity and reliability. Representations in the security system. Stored procedures in the security system. Triggers in the security system. Transactions and locks in the security system. Backup and restore the database. Logical security systems for SQL servers. Monitoring and auditing. Encryption in the database.	5	v				v		
7	Quantum Cryptography	The study of a communication protection method based on the principles of quantum physics. The technology of quantum cryptography. quantum cryptanalysis. Quantum key distribution protocols. Quantum protocols for solving mathematical problems. Vulnerability of the quantum system implementation.	5					v	v	
8	Big Data Processing	The study of theoretical and practical aspects of the use of big data technologies in information systems. Models with a unified memory access system and a non-unified one are considered. Strongly coupled and weakly coupled distributed computing systems. The problems of stability of such systems and the definition of computing power.	5	v			v			
9	Machine Learning & Deep Learning	The course is a comprehensive study of a class of machine learning algorithms such as convolutional, recurrent, and recursive neural networks. Combining these methods, complex systems are created that meet various tasks of artificial intelligence. Deep learning is a proven sample from a wide family of machine learning methods for	5	v			v			

		representing data that best suits the nature of the task.								

5.Учебный план образовательной программы