Institute of Automation and Information Technologies
Department of Automation and Control

EDUCATIONAL PROGRAM
8D07101 - AUTOMATION AND ROBOTIZATION

code and name of the educational program

Code and classification of the field of education: 8D07 Engineering, manufacturing and construction industries
Code and classification of areas of study: 8D071 Engineering and Engineering
Group of educational programs: D100 Automation and control
NQF level: 8
ORC level: 8
Duration of study: 3 years
Volume of credits: 180 credits

Almaty 2022

The educational program **"8D07101 - Automation and robotization"** was approved at a meeting of the Academic Council of KazNRTU named after. K.I.Satpayev.

Protocol №13 dated April 28, 2022

Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after. K.I. Satpayev.

Protocol № 7 dated April 26, 2022

The educational program "8D07101 - Automation and robotization" was developed by the academic committee in the direction "8D071 - Engineering".

FULL NAME	Scientific degree / scientific title	Job title	Workplace	signature
Chairman of the Scientific Committee:				
Aldiyarov Nakhypbek Ualievich	Candidate of Physics and Mathematics Sciences	Head of the "Automation and Management" department	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77772746301	
Teaching staff				
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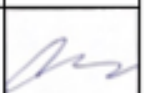
Beysembaev Akambay Agibaevich	Candidate of technical sciences, associate professor	Associate Professor	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77783337261	
Sarsenbayev Nurlan Saduakasovich	Candidate of technical sciences	Associate Professor	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77055716781	

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List of abbreviations and symbols

OP	Educational program
DC	Dynamic systems
SU	Control systems
PP	Teaching practice
IP	Research practice

1. Description of the educational program

The educational program (hereinafter EP) is a set of documents developed by the Kazakh National Research Technical University named after K.I. Satpayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan.

The educational program 8D07101 - Automation and Robotization of Doctor of Philosophy training has a scientific and pedagogical focus and involves fundamental educational, methodological and research training and in-depth study of disciplines in the areas of automation and robotics for the postgraduate education system and the research sector.

Objects of professional activity:

- automation and process control systems;
- robotic systems and complexes;
- training of undergraduate, graduate and doctoral students in special disciplines.

Types of work activity of doctoral graduates in the management of automated systems should have competencies in accordance with the types of professional activity:

in the field of production and technological activities:

- be the head of the production unit for the operation, maintenance, repair and adjustment of technical means of automated control systems for production processes in various industries;

in the field of organizational and managerial activities:

- to be the head of the scientific department dealing with the problems of automation of production processes, the department of the university, the department for the operation, maintenance and repair of elements, automated devices and control systems for production processes in various industries;

in the field of experimental research activities:

- to be the head of a scientific laboratory for conducting theoretical and experimental studies of industrial automation objects;

in the field of research and teaching activities:

- be a leading researcher or head of a scientific laboratory for the research and development of modernautomated control systems in various industries;
- be a teacher of undergraduate, graduate and doctoral disciplines in special disciplines in the field of automated systems management and automation of production processes;

in the field of designdesign activities:

- to be the head of the department for the development and design of automated control systems for production processes in various industries.

In the field of control of robotic systems, he must have competencies in accordance with the types of professional activity:

in the field of production and technological activities:

- be the head of the production unit for the operation, maintenance, repair and adjustment of technical means of robotic systems in various industries;

in the field of organizational and managerial activities:

- to be the head of the scientific department dealing with the problems of robotization of production processes; subdivisions of the university, subdivisions for the operation, maintenance and repair of elements, devices of robotic systems in various industries;

in the field of experimental research activities:

- to be the head of a scientific laboratory for conducting experimental studies of objects of robotization of industrial production;

in the field of research and teaching activities:

- be a leading researcher or head of a scientific laboratory for the research and development of modernrobotic systems, in various industries;
- be a teacher of undergraduate, graduate and doctoral studies in special disciplines in the field of control of robotic systems and robotization of production processes;

in the field of designdesign activities:

- to be the head of the division for the development of robotic systems in various industries.

2. CPurpose and objectives of the educational program

Purpose of the OP: The purpose of the educational program is to train doctoral students in basic and specialized disciplines, prepare and defend a dissertation with the achievement of relevant competencies.

Tasks of the OP:

Based on the achievements of modern science, technology and production, to provide knowledge and skills in the field of:

- automation;
- robotics;
- artificial intelligence;
- automated control;
- Preparation and defense of a doctoral dissertation.

3. Requirements for evaluating the learning outcomes of an educational program

OP 8DO7101 - "Automation and Robotization" ensures that all students achieve the learning outcomes necessary for professional activities. At the end of the program, students should:

- own the methods of system analysis: data collection, research of information flows, building models and choosing the structures of automated and robotic systems.
- know the basic methods of analysis and synthesis of dynamic systems (DS): bifurcation theory, fractal dimension and catastrophe theory.
- own intellectual methods of synthesis of control systems: expert systems, fuzzy logic, neural network structures.

- own methods of synthesis of optimal and adaptive control systems. Know the basics of solving classical and non-classical problems of the calculus of variations.

- possess the skills of conducting research work and preparing scientific publications on the development of automated process control systems and robotic technological complexes in various industries.

- be able to perform computational research work on the design and operation of control systems based on modern computer technology.

4. Passport of the educational program

4.1. General information

No.	Field name	Note
1	Code and classification of the field of education	8D07 Engineering, manufacturing and construction industries
2	Code and classification of areas of study	8D071 Engineering and Engineering
3	Group of educational programs	D100 Automation and control
4	Name of the educational program	8D07101 - Automation and robotics
5	Brief description of the educational program	The educational program 8D07101 - Automation and Robotization of Doctor of Philosophy training has a scientific and pedagogical focus and involves fundamental educational, methodological and research training and in-depth study of disciplines in the areas of automation and robotics for the postgraduate education system and the research sector.
6	Purpose of the OP	The purpose of the educational program is to train doctoral students in basic and specialized disciplines, prepare and defend a dissertation with the achievement of relevant competencies.
7	OP type	New OP
8	NQF level	eight
9	ORC level	eight
10	Distinctive features of the OP	Not
11	List of competencies of the educational program:	A doctoral student who graduates from this program acquires the following competencies: - own the methods of system analysis: data collection, research of information flows, building models and choosing the structures of automated and robotic systems. - generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge. - demonstrate teaching skills in undergraduate and graduate programs, supervise the scientific work of students and undergraduates. - to contribute with their own original research to the expansion of the scientific field, which deserve publication at the national or international level. - demonstrate high professional qualities and ethics when interacting with various stakeholders.

12	Learning outcomes of the educational program:	PO1 Master the methods of system analysis: data collection, research of information flows, building models and choosing the structures of automated and robotic systems. PO2 Know the basic methods of analysis and synthesis of dynamical systems (DS): bifurcation theory, fractal dimension and catastrophe theory. PO3 Own intelligent methods of synthesis of control systems: expert systems, fuzzy logic, neural network structures. PO4 Own methods of synthesis of optimal and adaptive control systems. Know the basics of solving classical and non-classical problems of the calculus of variations. PO5 Have the skills to conduct research and prepare scientific publications on the development of automated process control systems and robotic technological complexes in various industries. PO6 To be able to perform computational research work on the design and operation of control systems based on modern computer technology.
13	Form of study	full-time
14	Training period	3 years
15	Volume of loans	180 credits
16	Languages of instruction	Kazakh, Russian
17	Awarded Academic Degree	Doctor of Philosophy (PhD)
18	Developer(s) and authors:	Aldiyarov N.U., Zhanabaeva E.Zh.

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

No.	Name of the discipline	Brief description of the discipline	Number of credits	Formed learning outcomes (codes)					
				PO1	PO2	PO3	PO4	RO5	RO6
Cycle of basic disciplines University component									
1	Scientific research methods	The concept of science and scientific research, methods and methodology of scientific research, methods of collecting and processing scientific data, principles of organizing scientific research, methodological features of modern science, ways of developing science and scientific research, the role of technical sciences, informatics and engineering research in modern science, structure technical sciences, the application of general scientific, philosophical and special methods of scientific research in theory and practice.	5					v	
2	academic writing	The course aims to develop academic writing skills and writing strategies in doctoral students in the field of engineering and natural sciences. The course focuses on the fundamentals and general principles of academic writing for; writing effective sentences and paragraphs; use of tenses in scientific literature, as well as styles and punctuation; writing an abstract, introduction, conclusion, discussion, conclusion, literature and resources used; citations in the text; preventing plagiarism, and preparing a presentation at the conference.	5	v					
3	Theory of dynamical systems	The course covers the following main sections of the theory of dynamical systems: - Basic concepts of the theory of dynamical systems. – Mathematical models and classification of dynamic systems. – Analysis of dynamic systems on the phase plane. – Basic concepts of singularity theory, bifurcation theory, fractal dimension. – Chaotic dynamics and dynamic chaos. – Structural stability of nonlinear systems and catastrophe theory.	5	v	v				
4	Teaching practice	Pedagogical practice (PP) is the most important component and part of the educational process of doctoral students. The objectives of the teaching practice of doctoral students are to consolidate the knowledge, skills and abilities acquired by doctoral students in the process of studying the disciplines of the doctoral program. Pedagogical practice is carried out at the graduating department, wh trains doctoral students. The terms and duration of the practice	ten	v					

		established in accordance with the curricula and the calendar schedule the educational process. FROMThe content of the PC is planned by the supervisor of the docto candidate, agreed with the head of the doctoral training program and reflected in the doctoral student's report on PC and in the individual p of the doctoral student. During the internship, the doctoral candidate must master the skills of independent scientific and pedagogical activity in the professional field.							
Cycle of major disciplines University component									
5	Research practice	Research practice (IP) is a form of professional training of doctoral students for scientific and pedagogical activities, which is a type of practical activity of doctoral students related to conducting scientific research within the framework of the chosen topic of doctoral work, preparing scientific publications, final scientific qualification work (dissertation) and her subsequent defense. Research practice is a component of the main professional educational programs of doctoral studies. The purpose of the research practice is to develop the skills and abilities of doctoral students to conduct scientific research in the chosen direction, to use scientific methods in conducting research, to analyze, generalize and use the results obtained.	**ten**	**v**					
Cycle of major disciplines Selectable Component									
6	Modern technical means in control systems	The course "Modern technical means in control systems" considers the technical means of automation and control systems for technical objects and technological processes, such as controlled voltage converters, automated direct and alternating current electric drives, instrumentation, actuators, technical means for receiving, converting and transmitting measuring and command information via communication channels, technical means for processing, storing information and generating control actions, industrial information networks, software, technical means for displaying technological processes.	5			**v**			**v**
7	Power electronics	The discipline "Electronics of power devices" is one of the basic special courses for the specialty of automation and control. The course consists of the main parts: AC to DC conversion - rectifiers; pulse regulation of direct and alternating voltage - pulse converters; frequency regulation of voltage or current - frequency converters.	5						**v**
8	Mathematical methods of adaptive	The course covers the following main sections of adaptive systems: -	5			**v**	**v**		

	control	Management under uncertainty. Basic concepts and approaches to the formation of the concept of adaptive control. - Tasks and methods of synthesis of adaptive control systems. - Adaptive systems of identification type. - Discrete adaptive systems with customizable control object model. - Direct adaptive control. Adaptive systems with explicit and implicit reference model of the main contour. - Adaptive neural network control systems.							
9	Diagnostic subsystems in control systems (with AI elements)	The discipline "diagnostic subsystems in control systems" presents the basic concepts and definitions found in the theory of reliability, quantitative indicators of system reliability, methods for calculating systems for reliability, system redundancy, testing systems for reliability, processing test results and evaluating reliability indicators. The purpose of this diagnostic system is the joint analysis of interrelated controlled technological characteristics. The issues of application of intelligent technologies for the synthesis of subsystems of diagnostics of technological equipment are considered.	5						**v**

5. Curriculum of the educational program

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairperson of the Management Board-
Rector of the KazNRTU named after K.I. Satpayev
_____ A.M. Sagintaev
"___" _____ 2022 y.

CURRICULUM
of Educational Program on enrollment for 2022-2023 academic year
Educational program 8D07101 - "Automation and robotization"
Group of educational programs D100 - "Automation and control"

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 semesters					
								1 course		2 course		3 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)													
MET322	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													
AUT314	Theory of Dynamic Systems	BD UC	5	150	2/0/1	105	E	5					
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity (component of choice)													
M-2.1. Module innovative technologies in control systems													
AUT305	Modern technical means in control systems	PD, CCH	5	150	2/0/1	105	E	5					
AUT316	Electronics power devices			150	1/1/1	90	E	5					
AUT317	Mathematical methods of adaptive control	PD, CCH	5	150	2/0/1	105	E	5					
AUT302	Subsystems of diagnostics in control systems			150	2/0/1	105	E	5					
M-3. Practice-oriented module													
AAP350	Pedagogical practice	BD UC	10						30				
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 Kazatu named after K.Satpayev. Protocol №3 от "28" 04 2022г.

Decision of the Educational and Methodological Council of Kazatu named after K.Satpayev. Protocol №7 от "26" 04 2022 г.

Decision of the Academic Council of the Institute AaIT. Protocol №6 от "27" 01 2022 г.

Vice-Rector for Academic Affairs		B.A. Zhautikov
Director of the Institute of AaIT		R.K. Ushenbayeva
Head of the Department of AaC		N.U. Aldiyarov
Representative of the Council from employers		S.K. Abdigaliyev

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of development additional educational programs (Minor)