Institute of Automation and Information Technologies
Department "Automation and control"

EDUCATIONAL PROGRAM
7M07114 - AUTOMATION AND ROBOTIZATION

code and name of the educational program

Code and classification of the field of education: **7M07 Engineering, manufacturing and construction industries**
Code and classification of areas of study: **7M071 Engineering and Engineering affairs**
Group of educational programs: **M100 Automation and management**
NQF level: **7**
ORC level: **7**
Duration of study: **1.5 years**
Volume of credits: **90 credits**

Almaty 2025

The education program **"7M07114 – Automation and robotization"** was approved at a meeting of the Academic Council of KazNITU named after K. I. Satbayev.

Protocol №10 «06» March 2025 y.

Reviewed and recommended for approval at the meeting of the Teaching and Methodological Council of KazNITU named after K. I. Satbayev.

Protocol №3 «20» December 2024 y.

The educational program **«7M07114 – Automation and robotization»** has been developed by the academic committee of **«7M071 Engineering and Engineering affairs».**

Full name	Scientific degree / Academic title	Position	Workplace	Caption
Chairman of the academic committee:				
Sarsenbayev Nurlan	Candidate of technical sciences	Associate professor, head of the department	NAO «Kazakh National Research Technical University named after K. I. Satbayev»	
Teaching staff:				
Suleymenov Batyrkbek	Doctor of technical sciences	Professor	NAO «Kazakh National Research Technical University named after K. I. Satbayev»	
Beisembayev Akhambay	Candidate of technical sciences	Associate professor	NAO «Kazakh National Research Technical University named after K. I. Satbayev»	
Shiryayeva Olga	Candidate of technical sciences	Associate professor	NAO «Kazakh National Research Technical University named after K. I. Satbayev»	
Omirbekova Zhanar	Doctor PhD	Associate professor	NAO «Kazakh National Research Technical University named after K. I. Satbayev»	
Employers:				
Abdigaliyev Serik	APCS engineer	General director	LLP «АСУТП-Honeywell»	
Saurambayev Zhiger	APCS engineer	Head of Industrial Automation and Solutions for Kazakhstan and Central Asia	Schneider Electric Kazakhstan	
Yunatanov Yurii	APCS engineer	General director	Process Automation LLP, Kazakhstan	
Students:				
Shukenov Zhalgas	Master	1st year master's student	-	

Table of Contents

List of abbreviations and symbols

EP	Educational program
LSU	Microprocessor control systems
RFP	Application package

1. Description of the educational program

The educational program (here in after 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.

Educational program 7M07114 - «Automatization and Robotization» involves the training of highly qualified specialists in the field of automation, robotics, artificial intelligence and automated control.

The bachelor's degree in the EP «Automatization and Robotization» provides for the acquisition of competencies in a wider area: automation, robotics, artificial intelligence and automated control in order to ensure the adaptation of bachelor's graduates to the requirements of the labor market. This EP of the master's program provides for further deepening of the competencies acquired in the bachelor's degree. In this connection, modern innovative disciplines have been introduced into the program for each of the trajectories.

In the process of mastering the educational program, the Master of Technical Sciences in the field of automation of production processes must acquire the following key competencies:

- will be able to analyze literature data and, on the basis of the analysis, determine and experimentally implement possible ways to modernize automated and robotic systems using new technical solutions.
- will be able to apply appropriate methods of analysis, both qualitative and quantitative, to collect and integrate information in the best possible way.
- will be able to conduct independent original research that contributes to the development of science, in accordance with the best practices and industry standards.
- have the skills to create robotic systems and automated technological complexes.
- have professional knowledge in the field of automation, robotization, artificial intelligence and automated control.

Objects of professional activity:

- automation and process control systems;
- robotic systems and complexes;

The Master in Automation of Production Processes must solve the following tasks in accordance with the types of professional activity:

in the field of production and technological activities:

- to be a leading engineer, a leading specialist 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 department for the maintenance and repair of elements, devices of automated control systems for production processes in various industries;

in the field of experimental research activities:

- to be a leading specialist in conducting experimental studies of industrial automation objects;

in the field of research and teaching activities:

- be a researcher in a scientific laboratory for the research and development of modern automated control systems for production processes in various industries;

in the field of design design activities:

- be a leading engineer or chief engineer of a project for the development and design of automated control systems for production processes in various industries.

2. Purpose and objectives of the educational program

Purpose of the EP:

Training highly qualified specialists who are proficient in modern methods of automation, robotics, and intelligent control, capable of innovative activities and the development of sustainable technological solutions.

Tasks of the EP:

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.

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

OP 7MO7114 - «Automatization and Robotization» ensures that all students achieve the learning outcomes necessary for professional activities. At the end of the program, the student must:

- freely use in professional activities of the state, Russian and one of the most common, foreign language.
- master the main methods: data mining, descriptive analysis, correlation and regression analysis, classical calculus of variations, matrix description of spatial mechanisms.
- to master the main methods of modern control theory: synthesis of systems with a given dynamics using standard and relay controllers, digital control systems, systems with variable structure, modal control, identification and adaptation and optimal control.
- freely master the basics of philosophical, pedagogical, economic knowledge.
- possess the skills of describing the kinematics and dynamics of industrial robots, methods of developing software trajectories, developing adaptive and non-adaptive control algorithms for industrial robots.

- to have the skills to create automated process control systems and robotic technological complexes.

- knowledge of modern technical means of automation and robotics. Own the basics of the practical application of modern technical means of automation.

- to possess the skills of building microprocessor systems (MSU). To be able to design hardware and software of MSU.

- possess the skills of software and stabilizing, optimal and adaptive control and synthesis of intelligent control systems.

- to possess the skills to conduct research and design work on the development of automated process control systems and robotic technological systems in various industries.

4. Passport of the educational program

4.1. General information

No.	Field name	Note
1	Code and classification of the field of education	7M07 Engineering, manufacturing and construction industries
2	Code and classification of areas of study	7M071 Engineering and Engineering affairs
3	Group of educational programs	M100 Automation and management
4	Name of the educational program	7M07114 - Automation and robotization
5	Brief description of the educational program	Educational program 7M07114 - Automatization and robotization involves the training of highly qualified specialists in the field of automation, robotics, artificial intelligence and automated control.
6	Purpose of the EP	Training highly qualified specialists who are proficient in modern methods of automation, robotics, and intelligent control, capable of innovative activities and the development of sustainable technological solutions.
7	EP type	New EP
8	NQF level	7
9	ORC level	7
10	Distinctive features of the EP	No
11	List of competencies of the educational program:	In the process of mastering the educational program, the Master of Technical Sciences in the field of automation of production processes must acquire the following key competencies: - will be able to analyze literature data and, on the basis of the analysis, determine and experimentally implement possible ways to modernize automated and robotic systems using new technical solutions. - will be able to apply appropriate methods of analysis, both qualitative and quantitative, to collect and integrate information in the best possible way. - will be able to conduct independent original research that contributes to the development of science, in accordance with the best practices and industry standards. - have the skills to create robotic systems and automated technological complexes. - have professional knowledge in the field of automation, robotization, artificial intelligence and automated control.
12	Learning outcomes of the educational program:	LO1 – Be fluent in the basics of psychology, philosophical, pedagogical and economic knowledge. LO2 – Know the basic methods of modern control theory: synthesis of systems with given dynamics using standard and relay controllers, digital control systems, systems with variable structure, modal control, identification and adaptation of optimal control. LO3 – Possess the skills of software and stabilizing, optimal

		and adaptive control and synthesis of intelligent control systems. LO4 – Possess the skills of conducting research and design work on the development of automated process control systems and robotic technological systems in various industries. LO5 – Possess skills in working with data from automated and robotic production processes, including collecting, processing, analyzing and visualizing data for making operational decisions and optimizing production processes, diagnosing and ensuring the reliability of automation systems. LO6 – Know modern technical means of automation and robotics. Possess the basics of practical application of modern technical automation equipment. LO7 – Designing hardware and software components of microprocessor systems, developing and synthesizing digital, integrated, and distributed control systems, contributing to the development of the digital industry. LO8 – Freely use the state, Russian and one of the common foreign languages in professional activities. LO9 – Mastering the basic methods: intellectual data analysis, descriptive analysis, correlation and regression analysis, classical variational calculus, matrix description of spatial mechanisms. LO10 – The ability to design modern and reliable units and devices, intelligently controlled modules of robotic and automated systems for sustainable production.
13	Form of study	full-time
14	Training period	1.5 years
15	Volume of credits	90 credits
16	Languages of instruction	Kazakh, Russian
17	Awarded Academic Degree	Master of Engineering
18	Developer(s) and authors:	Aldiyarov N.U., Manatov K. A.

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	Amount of credits	Formed learning outcomes (codes)									
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10
Cycle of basic disciplines University component													
1	Foreign language (professional)	The purpose of the discipline is to acquire and improve competencies in accordance with trade standards of foreign education, capable of competing in the labor market, because through a foreign language, the future master gains access to academic knowledge, new technologies and modern information, allowing the use of a foreign language as a means of communication in the intercultural, professional and scientific activities of the future master.	2								V		
2	Management	Purpose: To form a scientific understanding of management as a type of professional activity. Contents: Mastering the general theoretical principles of managing socio-economic systems; acquiring skills and abilities in practical problem-solving of managerial issues; studying global management practices and the specificities of Kazakhstani management; training in solving practical issues related to managing various aspects of organizational activities.	2	V									
3	Psychology of management	Objective: To acquire skills in making strategic and managerial decisions, taking into account the psychological characteristics of the individual and the team. Content: the modern role and content of psychological aspects in management activities, methods for improving psychological literacy, the composition and structure of management activities, both at the local and foreign levels, the psychological feature of modern managers.	2	V									
Cycle of basic disciplines Selectable Component													
4	Integrated automation technology and management	The task of studying the discipline is to acquire knowledge on effective technologies for modeling automation objects, to study the directions of development of automation tools, fundamentally new methods of process control, computer-integrated production of a new generation, as well as to acquire skills in forming a production	4						V			V	

		automation strategy, the use of modern automation devices to solve control problems, the formation of sets of modern sensors and converters to combine them into a computer-integrated production system.											
5	Intelligent technology in robotics	The course "Intelligent technologies in robotics" discusses the main characteristics of robots: load capacity, coordinate movement system, the number of degrees of mobility; the speed of movement and the magnitude of the stroke of each link, the positioning error, the method of installation in the workplace, the working service area. Classification and principles of construction of robotic systems. Technological requirements for robotic systems used in enterprises. An actively developing field of artificial intelligence. It includes models, methods and algorithms focused on automatic accumulation and formation of knowledge based on data analysis and generalization. It includes example-based (or inductive) learning, as well as traditional approaches from pattern recognition theory.	5		**V**						**V**		
6	Data Mining Methods	The discipline considers the most common methods and algorithms of data mining. Special attention is paid to understanding the principles and concepts underlying modern intellectual methods. Using practical examples, the features of data analysis when conducting research in the field of automation and control are considered.	5									**V**	**V**
7	Modern control theory	The content of the discipline includes the study of modern approaches for the analysis and synthesis of automatic control systems based on the “state space” methodology. The properties of linear and nonlinear systems and methods for their study are considered from a unified positions of the state space method. Provided basic information about systems with variable structure, modal control, identification, adaptation and optimization in control systems.	4				**V**					**V**	
8	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5							**V**			**V**
Cycle of major disciplines University component													

9	Automation of engineering systems	The content of the discipline includes the methodological foundations for creating an automated system for technological preparation of production (APS). Taking into account the trends in the development of modern industrial production and new information technologies for its automation, the main principles for building the architecture of an IT system are formulated.	5				**V**		**V**	**V**			
10	Complex control systems	The objective of studying the discipline is to acquire knowledge of modern automation technologies and control of real multidimensional and multi-connected complex systems with several adjustable circuits, as well as to acquire skills in developing a production automation strategy, using modern automation devices to solve problems of controlling complex systems, solving modeling and analysis problems and synthesis of complex control systems. The purpose of teaching the discipline is to study modern methods and principles of managing complex, multidimensional and multi-connected systems.	4	**V**					**V**				
Cycle of major disciplines Selectable Component													
11	Automation of control systems design	The content of the discipline "Automation of control systemы design" includes the study of methods of analysis and synthesis of control systems, the choice of structure and the calculation of parameters of the control law. The procedures of analytical design of regulators, development of structural, functional and other automation schemes with the use of modern application software packages are considered.	5		**V**		**V**						
12	Automated projection of robotic systems	The course "Automated projection of robotic systems" examines the training of specialists who know the theoretical foundations of control system design and methods of performing experimental and computational work on the creation and operation of automation systems based on modern software and hardware.	5					**V**					**V**
13	Machine Learning Algorithms in Technological Process Automation	COURSE AIM AND OBJECTIVES The purpose of the discipline is to study methods of machine learning and analysis of big data for making management decisions in automated control systems of technological processes. The course focuses on determining the key variables of technological processes, identifying their interdependence and their impact on qualitative and quantitative indicators of production. Processing and analysis of large amounts of technological data. Particular attention is paid to machine learning algorithms that allow you to establish complex technological relationships without building complex mathematical models in conditions of uncertainty.	5		**V**		**V**						

14	Machine Learning Algorithms in Equipment Condition Diagnostic Systems	The purpose of the discipline is to analyze technological equipment in terms of diagnosing its condition and studying methods of machine learning and big data analysis to solve problems related to the identification of the technical condition of equipment. The course deals with the development of modern systems of equipment condition identification and strategies for maintenance and repair of equipment - according to the actual state. These systems are based on machine learning (ML) algorithms. Within the framework of the course the possibility of application of modern ML algorithms for equipment diagnostics, such as Decision Tree, Random Forest and others is considered. Python programming language is used to implement these algorithms.	5					**V**					
15	Diagnostics of system automation	The content of the discipline includes the characteristics of qualitative and quantitative indicators of the reliability of technical systems, their probabilistic and statistical evaluation based on test results, the analysis of the need and the choice of the redundancy rate, consideration of methods and models of technical diagnostics of automation systems.	5			**V**		**V**						
16	Dynamics of robot control	The content of the discipline “Dynamics of robots control” includes the study of mathematical approaches for cyclic, positional and contour control of industrial robots, models and algorithms for kinematic and dynamic analysis of industrial robots, studies of the kinematics and dynamics of the manipulator and drive system of an industrial robot.	5									**V**		
17	The reliability of the management system and its elements	The discipline "Reliability of the control system and its elements" examines the basic terms, definitions and concepts in the theory of reliability, quantitative indicators of the reliability of renewable and non-renewable technical systems, the main methods for calculating the reliability of complex systems, types of tests for reliability, backup issues and determining the reliability of backup systems. To consolidate the theoretical materials, standard tasks are presented. As well as issues of reliability of automation and control systems.	5						**V**					
18	New information technologies	The course "New Information Technologies" discusses fundamental problems and mathematical methods of systems theory, characteristics of the stages of system analysis, system analysis procedures, data collection on the functioning of the system, the study of information flows, the construction of models of systems, checking the adequacy of models, uncertainty and sensitivity analysis, the study of resource capabilities, determining the goals of system analysis, the formation of criteria, generating alternatives, the implementation of choice and decision-making; Models of	5	**V**										

		complex systems; Classification of types of modeling of complex systems, principles and approaches to the construction of mathematical models, stages of building a mathematical model, methods of qualitative evaluation of systems, methods of quantitative evaluation of systems, decision-making in conflict, risk, uncertainty, intelligent models in management.											
19	Automation systems design	In the discipline, the stages of designing process control systems are studied. Methods of preparation of project documentation in accordance with modern international standards; methods of automating the construction of mathematical models, analysis and synthesis systems using modern computer technologies and automation of scientific research; trends in the development of science and technology and their impact on automation; The essence of a systematic approach in the design of modern hardware and software computing.	5						**V**				
20	Project Management	Goal: Gaining knowledge about the components and methods of project management based on modern models and standards. Objectives: study of behavioral models of project-oriented management of business development; mastering international standards PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management; analysis of the features of organizational management of business development through the integration of strategic, project and operational management.	5					**V**			**V**		
21	Distributed Control Systems	The content of the discipline "Distributed control systems" deals with the choice of structure and composition of hardware and software for distributed control systems. A distributed control system (DCS, DCS - Distributed Control System) can be defined as a system consisting of many devices spaced apart in space, each of which is independent of the others, but interacts with them to perform a common task. The maximum benefits of a distributed system are achieved when controllers work autonomously, and the exchange of information between them is minimized.	5			**V**			**V**				
22	Optimal control systems (with AI elements)	The content of the discipline "Optimal control systems" includes the study of mathematical methods of optimal control based on classical calculus of variations, the basics of the maximum principle and the method of dynamic programming. Models and methods of program and stabilizing optimal control are considered. Methods of synthesis of intelligent optimal control systems are considered separately.	5									**V**	
23	Technical Vision system	In the discipline "Systems of technical vision", the main types of technical vision systems used in real-time control systems, the	5		**V**		**V**						

		features of hardware and software technical vision, methods of organizing and conducting experimental research in the field of technical vision systems are considered. The methods of processing and transformation of inventions are being studied.												
24	Modern executive devices of automation systems	The course content discusses general issues of the theory of automation actuators, outlines the principles of classification of actuators and their main characteristics, as well as issues related to actuators as an element of an automation system. The main purpose of the training is to teach the ability to correctly select installation devices in automation systems	5		**V**		**V**							
25	Digital control systems	The content of the discipline "Digital Control Systems" includes the study of the mathematical apparatus for describing digital systems, describing digital systems in the time and frequency domains, and synthesizing digital controllers in the automation of production processes. Obtaining knowledge about the principles of construction and features of the use of digital control systems in industry.	5			**V**	**V**							

5. Curriculum of the educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year	**2025-2026 (Autumn, Spring)**
Group of educational programs	**M100 - "Automation and management"**
Educational program	**7M07114 - "Automation and robotization"**
The awarded academic degree	**Master of engineering and technology**
Form and duration of study	**full time (professional track) - 1,5 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters			Prerequisites
									1 course		2 course	
									1 sem	2 sem	3 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)												
CYCLE OF BASIC DISCIPLINES (BD)												
M-1. Module of basic training (university component)												
MNG726	Management		BD, UC	2	60	15/0/15	30	E	2			
HUM211	Psychology of management		BD, UC	2	60	15/0/15	30	E	2			
LNG212	Foreign language (professional)		BD, UC	2	60	0/0/30	30	E	2			
M-2. Module of theoretical foundations of management												
AUT711	Modern control theory	1	BD, CCH	4	120	30/0/15	75	E	4			
AUT712	Integrated automation technology and management	1	BD, CCH	4	120	30/0/15	75	E	4			
AUT266	Data Mining Methods	2	BD, CCH	5	150	30/0/15	105	E	5			AUT104
AUT267	Intelligent technology in robotics	2	BD, CCH	5	150	30/0/15	105	E	5			AUT166
MNG782	Sustainable development strategies	2	BD, CCH	5	150	30/0/15	105	E	5			
CYCLE OF PROFILE DISCIPLINES (PD)												
M-2. Module of theoretical foundations of management												
AUT708	Automation of engineering systems		PD, UC	5	150	30/0/15	105	E	5			
AUT299	Diagnostics of system automation	1	PD, CCH	5	150	30/0/15	105	E		5		
AUT700	The reliability of the management system and its elements	1	PD, CCH	5	150	30/0/15	105	E		5		AUT112
AUT225	Automation systems design	2	PD, CCH	5	150	30/0/15	105	E		5		AUT166
AUT707	Distributed Control Systems	2	PD, CCH	5	150	30/0/15	105	E		5		AUT268
MNG705	Project Management	2	PD, CCH	5	150	30/0/15	105	E		5		
M-3. Module of control system design												
AUT709	New information technologies	1	PD, CCH	5	150	30/0/15	105	E	5			
AUT285	Modern executive devices of automation systems	1	PD, CCH	5	150	15/15/15	105	E	5			AUT108
AUT714	Machine Learning Algorithms in Technological Process Automation	2	PD, CCH	5	150	30/15/0	105	E	5			
AUT715	Machine Learning Algorithms in Equipment Condition Diagnostic Systems	2	PD, CCH	5	150	30/15/0	105	E	5			
AUT705	Optimal control systems (with AI elements)	1	PD, CCH	5	150	30/0/15	105	E		5		AUT268
AUT706	Technical Vision system	1	PD, CCH	5	150	30/0/15	105	E		5		AUT267
AUT237	Digital control systems	2	PD, CCH	5	150	30/0/15	105	E		5		AUT102
AUT251	Dynamics of robot control	2	PD, CCH	5	150	15/15/15	105	E		5		AUT104

AUT701	Automation of control systems design	3	PD, CCH	5	150	30/0/15	105	E		5		AUT166
AUT702	Automated projection of robotic systems	3	PD, CCH	5	150	30/0/15	105	E		5		
AUT716	Complex control systems		PD, UC	4	120	30/0/15	75	E			4	
M-4. Practice-oriented module												
AAP248	Internship		PD, UC	5				R		5		
M-5. Experimental and research module												
AAP249	Experimental research work of a master student, including an internship and the implementation of a master's project		ERWMS	18				R			18	
M-6. Module of final attestation												
ECA213	Design and defense of the master's project		FA	8							8	
Total based on UNIVERSITY:									30	30	30	
									60		**30**	

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	6	9	15
PD	Cycle of profile disciplines	0	14	35	49
Total for theoretical training:		**0**	**20**	**44**	**64**
RWMS	Research Work of Master's Student				0
ERWMS	Experimental Research Work of Master's Student				18
FA	Final attestation				8
TOTAL:					**90**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 22.11.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs — Uskenbayeva R. K.

Approved:

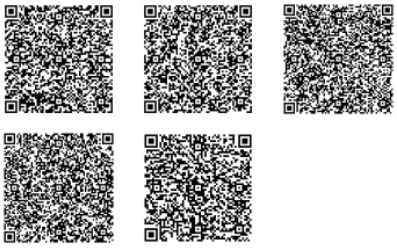
Vice Provost on academic development — Kalpeyeva Z. B.

Head of Department - Department of Educational Program Management and Academic-Methodological Work — Zhumagaliyeva A. S.

acting Director of Institute - Institute of Automation and Information Technologies — Chinibayev Y. G.

Department Chair - Automation and control — Sarsenbayev N. .

Representative of the Academic Committee from Employers ____Acknowledged____ — Saurambayev Z.



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)