Institute of Automation and Information Technologies
Department of Automation and Control

EDUCATIONAL PROGRAM
6B07103–AUTOMATION AND ROBOTIZATION

code and name of the educational program

Code and classification of the field of education: **6B07 Engineering, manufacturing and construction industries**
Code and classification of areas of study: **6B071 Engineering and Engineering**
Education Program Group: **B063–Electrical engineering and automation**
NQF level: **6**
ORC level: **6**
Duration of study: **4 years**
Volume of credits: **240 credits**

Almaty 2023

The educational program **«6B07103 - Automation and robotization»** was approved at a meeting of the Academic Council of KazNITU named after K.I. Satpayev.

Protocol № 5 «24» 11 2022 y.

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

Protocol № 3 «17» 11 2022 y.

The educational program **«6B07103 - Automation and robotization»** has been developed by the academic committee of **«6B071 Engineering and Technology»**.

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Table of contents

List of abbreviations and symbols

EP	Educational program
APCS	Automated process control system
ACS	Automatic control systems
CAD	Computer-aided design system
DAC	D/A Converter
ADC	Analog to digital converter

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 6B07103 - Automation and robotics in the direction of personnel training 6B071- "Engineering and Engineering" involves the training of highly qualified specialists in the field of operation, maintenance, development and implementation of automated process control systems (APCS), robotic technological complexes (RTC) in various industries.

A bachelor who graduates from this program acquires the following competencies: operation and maintenance of automated process control systems and RTK in various industries, development and implementation of technical, information and software for industrial production process control systems and RTK, conducting scientific research in the field of integrated automation and robotization of production processes , using modern software for designing and modeling production processes.

The objects of professional activity of the bachelor are: subdivisions of industrial enterprises for the operation and maintenance of APCS and RTK of various industries, subdivisions of state institutions for the operation and maintenance of automated information and control systems for various purposes, subdivisions of design organizations for the development, implementation and technical support of APCS and RTK of various industries, subdivisions of scientific organizations for research in the field of automation of technological processes, robotization of technological operations.

The types of professional activity are:

In the field of organizational and managerial activities: to be the head of the group of the unit for the operation, maintenance of elements,APCS and RTK in various industries;

In the field of experimental research activities: to be a specialist in conducting experimental research on objects of automation and robotization of industrial production;

In the field of research activities: to be an engineer in a scientific laboratory for the research and development of modern APCS and RTK in various industries;

In the field of design and development: to be a development and design engineer APCS and RTK in various industries.

2. Purposes and objectives of the educational program

Purpose of the EP: The purpose of the educational program 6B07103–"Automation and robotization" is the creation of conditions for an effective educational process for the formation and development of personal, socio-cultural, general engineering and professional competencies in the field of automation and robotics, meeting the needs of students in intellectual, creative and professional development.

Tasks of the OP:

- providing social and humanitarian education based on knowledge of the laws of socio-economic development of society, the history of Kazakhstan, modern information technologies, the state language, foreign and Russian languages as a means of interethnic communication;
- providing in-depth knowledge of a natural-science, general technical nature, as the foundation of vocational education;
- providing deep theoretical knowledge and practical skills in the fieldautomation, robotization, artificial intelligence and automated control;
- ensuring the adaptation of professionally oriented skills to the changing needs of society.

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

OP 6B07103 - "Automation and robotization" ensures that all students achieve the learning outcomes necessary for professional activities. Upon completion of the program, students must:

- possess the knowledge, skills and abilities to implement a systematic approach to the development and implementation of automation systems and robotization of production processes.
- to be able to make a choice of measuring instruments and automation equipment, measure technological parameters, configure and operate automation elements and devices.
- demonstrate knowledge of sections of higher mathematics, physics and other natural sciences and apply them to solve engineering problems in the field of automation and control.
- own modern computer, information, communication technologies and software used in the creation and operation of automation systems.
- be able to put into practice knowledge on the main types of linear and non-linear automatic control systems, their mathematical description and modeling, perform calculations on the analysis and synthesis of control systems.
- have programming skills in high-level languages, tools and programming languages for microcontrollers, software for modeling and researching process control systems.
- be able to navigate the current economic, political and corruption situation.
- own methods of information processing and synthesis of automation systems, methods of designing and programming data management systems. Use in practice the functionality of Scada-systems.
- develop structural, functional and other automation schemes, analyze reference and regulatory literature, draw up technical documentation. Develop technical, software, mathematical, algorithmic, informational and other support for process control systems.
- use the technical capabilities of microprocessor technology, means of

receiving and transmitting information and software products to solve automation problems.

- analyze and evaluate the state of automation objects, technological processes and industries. Make qualified decisions on the use of automation elements and systems, their installation, commissioning and operation.

- use modern tools and information and communication technologies in the design and implementation of process and production control systems.

4. Passport of the educational program

4.1. General intelligence

No.	Field name	Note
1	Code and classification of the field of education	6B07 Engineering, manufacturing and construction industries
2	Code and classification of areas of study	6B071 Engineering and engineering
3	Group of educational programs	B063–"Electrical Engineering and Automation"
4	Name of the educational program	6B07103–Automation and robotization
5	Brief description of the educational program	The educational program 6B07103 - Automation and robotics in the direction of personnel training 6B071- "Engineering and engineering" involves the training of highly qualified specialists in the field of automation, robotics, artificial intelligence and automated control.
6	Purpose of the OP	The purpose of the educational program 6B07103–"Automation and robotization" is the creation of conditions for an effective educational process for the formation and development of personal, socio-cultural, general engineering and professional competencies in the field of automation and robotics, meeting the needs of students in intellectual, creative and professional development.
7	OP type	New OP
8	NQF level	6
9	ORC level	6
10	Distinctive features of the OP	Not
11	List of competencies of the educational program:	A bachelor who graduates from this program acquires the following competencies: operation and maintenance of automated process control systems and RTK in various industries, development and implementation of technical, information and software for industrial production process control systems and RTK, conducting scientific research in the field of integrated automation and robotization of production processes , using modern software for designing and modeling production processes.
12	Learning outcomes of the educational program:	PO1 Possess the knowledge, skills and abilities to implement a systematic approach to the development and implementation of automation systems and robotization of production processes. PO2 Be able to select measuring instruments and automation equipment, measure technological parameters, configure and operate automation elements and devices. PO3 Demonstrate knowledge of sections of higher mathematics, physics and other natural sciences and apply them to solve engineering problems in the field of automation and control. PO4 Own modern computer, information, communication technologies and software used in the creation and operation of automation systems.

		RO5 To be able to put into practice knowledge on the main types of linear and non-linear automatic control systems, their mathematical description and modeling, perform calculations on the analysis and synthesis of control systems. RO6 To have programming skills in high-level languages, programming tools and languages for microcontrollers, software for modeling and researching process control systems. PO7 Be able to navigate the current economic, political and corruption situation. RO8 Own methods of information processing and synthesis of automation systems, methods of designing and programming data management systems. Use in practice the functionality of Scada-systems. RO9 Develop structural, functional and other automation schemes, analyze reference and regulatory literature, draw up technical documentation. Develop technical, software, mathematical, algorithmic, informational, etc. provision of process control systems. RO10 Use the technical capabilities of microprocessor technology, means of receiving and transmitting information and software products to solve automation problems. RO11 Analyze and evaluate the state of automation objects, technological processes and industries. Make qualified decisions on the use of automation elements and systems, their installation, commissioning and operation. PO12 Use modern tools and information and communication technologies in the design and implementation of process and production control systems.
13	Form of study	full-time
14	Training period	4 years
12	Volume of loans	240 credits
16	Languages of instruction	Kazakh, Russian
17	Awarded Academic Degree	Bachelor of Engineering and Technology
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	Amount of credits	Formed learning outcomes (codes)											
				PO1	PO2	PO3	PO4	RO5	RO6	RO7	RO8	RO9	RO10	RO11	RO12
Cycle of general education disciplines Required Component															
1	English language	English is a discipline of the general education cycle. After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and disciplines. The name of the discipline corresponds to the level of English proficiency. When moving from level to level, prerequisites and postrequisites of disciplines are observed.	10	v											
2	Kazakh (Russian) language	The socio-political, socio-cultural spheres of communication and functional styles of the modern Kazakh (Russian) language are considered. The course covers the specifics of the scientific style in order to develop and activate the professional communication skills and abilities of students, allows students to practically master the basics of the scientific style and develop the ability to perform structural and semantic analysis of the text.	10	v											
3	Information and Communication Technologies (in English)	Required component. The task of studying the discipline is to acquire theoretical knowledge about information processes, new information technologies, local and global computer networks, methods of information protection; obtaining skills in the use of text editors and spreadsheet processors; creation of databases and various categories of application programs.	5					v							
4	History of Kazakhstan	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan from ancient times to the present day. The sections of the discipline include: the steppe empire of the Turks; early feudal states on the territory of Kazakhstan; Kazakhstan in the period of	5		v										

		the Mongol conquest (XIII century), medieval states in the XIV-XV centuries. The era of the Kazakh Khanate XV-XVIII centuries. Kazakhstan as part of the Russian Empire, Kazakhstan during the Great Patriotic War, in the period of independence and at the present stage.													
5	Philosophy	Philosophy forms and develops critical and creative thinking, worldview and culture, provides knowledge about the most general and fundamental problems of being and endows them with a methodology for solving various theoretical practical issues. Philosophy expands the horizon of vision of the modern world, forms citizenship and patriotism, contributes to the education of self-esteem, awareness of the value of human existence. It teaches to think and act correctly, develops the skills of practical and cognitive activity, helps to seek and find ways and means of life in harmony with oneself, society, and the world around.	5							v					
6	Socio-political knowledge module (sociology, politology)	Studying the course contributes to the formation of students' theoretical knowledge about society as an integral system, provides the political aspect of training a highly qualified specialist on the basis of modern world and domestic political thought. The discipline is designed to improve the quality of both general humanitarian and professional training of students. Knowledge in the field of sociology and political science is necessary for understanding political processes, for forming a political culture, developing a personal position and a clearer understanding of the measure of one's responsibility.	3	v											
7	Socio-political knowledge module (culturology, psychology)	The module of socio-political knowledge (culturology, psychology) is designed to acquaint students with the cultural achievements of mankind, for their understanding and assimilation of the main forms and universal patterns of the formation and development of culture. During the course of cultural studies, general problems of the theory of culture, leading cultural concepts, universal patterns and mechanisms for the formation and development of culture, the main historical stages of the formation	5		v										

		and development of Kazakhstani culture are considered. It also studies the laws of the emergence, development and functioning of mental processes, states, properties of a person engaged in a particular activity, the laws of development and functioning of the psyche as a special form of life.														
Cycle of general education disciplines University component																
8	Fundamentals of anti-corruption culture and law	The course introduces students to the improvement of socio-economic relations of Kazakhstan society, psychological features of corrupt behavior. Special attention is paid to the formation of an anti-corruption culture, legal responsibility for acts of corruption in various spheres. The purpose of studying the discipline «Fundamentals of anti-corruption culture and law» is to increase public and individual legal awareness and legal culture of students, as well as the formation of a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to realize the values of moral consciousness and follow moral norms in everyday practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption.	5							v						
9	Fundamentals of Economics and Entrepreneurship	Discipline studies the foundations of economics and entrepreneurial activity from the point of view of science and law; features, problematic aspects and development prospects; the theory and practice of entrepreneurship as a system of economic and organizational relations of business structures; The readiness of entrepreneurs for innovative susceptibility. The discipline reveals the content of entrepreneurial activity, the stages of career, qualities, competencies and responsibility of the entrepreneur, theoretical and practical business planning and economic examination of business ideas, as well as the analysis of the risks of innovative development, the introduction of new technologies and technological solutions.	5							v						
10	Ecology and life safety	The discipline studies the tasks of ecology as a science, environmental terms, the laws of the	5											v		

		functioning of natural systems and aspects of environmental safety in the conditions of labor activity. Monitoring of the environment and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems; life safety in the technosphere; natural and man-made emergencies.													
11	Fundamentals of Scientific Research Methods	The course introduces students to the improvement of socio-economic relations of Kazakhstan society, psychological features of corrupt behavior. Special attention is paid to the formation of an anti-corruption culture, legal responsibility for acts of corruption in various spheres. The purpose of studying the discipline «Fundamentals of anti-corruption culture and law» is to increase public and individual legal awareness and legal culture of students, as well as the formation of a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to realize the values of moral consciousness and follow moral norms in everyday practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption.	5	v										v	
Cycle of basic disciplines University component															
12	Mathematics I	The course is devoted to the study of the basic concepts of higher mathematics and its applications. The main provisions of the discipline are applied in the teaching of all general education engineering and special disciplines taught by graduate departments. The course sections include elements of linear algebra and analytical geometry, an introduction to analysis, differential calculation of functions of one and several variables. Methods for solving systems of equations, problems of using vector calculations in solving problems of geometry, mechanics, and physics are considered. Analytical geometry on a plane and space, differential calculation of functions of one variable, derivatives and differentials, study of the behavior of functions, derivative and gradient in	5			v									

		direction, extremum of a function of several variables.													
13	Mathematics II	The discipline is a continuation of Mathematics I. sections of the course include integral calculus of a function of one variable and several variables, series theory. Indefinite integrals, their properties and methods of their calculation. Certain integrals and their application. Incorrect integrals. Numerical series theory, functional series theory, Taylor and Macloren Series, application of series to approximate calculations.	5			v									
14	Physics I	Objectives: to study the basic physical phenomena and laws of classical, modern physics; methods of physical research; the relationship of physics with other sciences. The following topics are considered: mechanics, dynamics of rotational motion of a solid body, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, transport phenomena, continuum mechanics, electrostatics, direct current, magnetic field, Maxwell equations.	5			v									
15	Physics II	The course studies the laws of physics and their practical application in professional activity. Solving theoretical and experimental-practical educational problems of physics for the formation of the foundations in solving professional problems. Assessment of the degree of accuracy of the results of experimental or theoretical research methods, modeling of physical condition using a computer, study of modern measuring equipment, development of skills for conducting test studies and processing their results, distribution of the physical content of applied tasks of the future specialty.	5			v									
16	Engineering and computer graphics	The discipline is aimed at the study of methods for the image of objects and the general rules of drawing, using computer graphics; the study of the basic principles and geometric modeling approach and methodology for developing applications with a graphical interface; the formation of skills in the use of graphic systems for the development of drawings, using 2D and 3D modeling methods.	5			v	v								

17	Introduction to the specialty and engineering ethics	The study of the discipline is the assimilation of the theoretical foundations of the ethics of business communication and the principles of ethics of business relations; features and problems associated with professional and in particular engineering ethics; The purpose of the course is to master the basics of automation, robotization, the ethical code of an engineer. As a result of studying the discipline, the student must know automation and process control; industrial robotics.	4											v	
18	Theoretical foundations of electrical engineering	It is considered in the discipline: basic concepts and definitions used in electrical engineering; modern methods of modeling of electromagnetic processes; methods of analysis of electric and magnetic circuits; numerical methods of the analysis of electrical circuits; basic laws and principles of electrical engineering, properties and characteristics of electrical circuits; methods of analysis of electrical circuits in steady state and transient modes; selection of the optimal method of calculation, to determination of the main parameters and characteristics of electrical circuits.	5		v										v
19	Basics of electronics	Formation of students' knowledge of the basics of electronics methods for designing and calculating electronic devices. Obtaining knowledge, skills and abilities to read structural and schematic diagrams of electronic devices, to understand the principles of their work and make the right choice of electronic components.	5		v										
20	Power electronics automation	The discipline is one of the basic special courses for the specialty of automation and robotics. The purpose of this course is to give students a fairly complete understanding of the electrical energy converters, their components, topology, mathematical descriptions, basic methods of analysis. As a result, students master the principles of operation of power electronic devices of automation; knowledge of the correct choice of elements and automation devices, calculate their characteristics.	4		v										
21	Process automation facilities	The content of the discipline "Process automation facilities" includes the study of mathematical	5												v

		methods of software control of robots, the basics of the development of algorithms and cyclograms of robot control. The structure and composition of cyclic, positional and contour systems of software control of robots, systems of digital software control of machines, machines are considered.													
22	Technology of robotic production	The discipline "Technology of robotic production" sets as the purpose to teach students of methodology of design of technological processes in the conditions of the automated production, independent development of technological processes of assembly of cars and production of their details. Questions of scientific bases of technology of mechanical engineering, preparation of robotic production, choice of preparations, the principles of design of technological processes in the conditions of automation are considered. Problems of studying of discipline is acquisition of knowledge of ensuring accuracy, control and tests of machine-building production. As a result of studying of discipline the trainee, has to know: design stages of the production technology of cars, standard technological processes of production of details of cars; the used equipment and the equipment in the conditions of robotic production. To be able: to put and solve problems of technical training of production; to develop technological processes of production of cars and details of the required quality in the conditions of robotic production.	6	v											
23	Mathematical foundations of control theory	This discipline is intended to study the methods of development of object models , control systems. The following sections are studied: the concept of the set, set operations, relations and mapping of sets, the concept of graph, adjacency and incidence matrices , graph operations, the concept of logic variable, function, operations on logical variables, basic logic functions, notations of logical functions, the concept of matrix , matrices operations, types of matrices, eigenvalues, Cayley-Hamilton theorem, matrix function, the concept of system, the description of the systems. This course is intended for formation of the	5			v									

		mathematical foundations of the development of models of control systems among students. . As a result of the acquirement of the discipline the will be able to formulate mathematical problems, develop mathematical models, select mathematical methods and algorithms for solution of the problem.														
24	Optimization methods	The discipline is designed to form students' systematized knowledge of modern methods of optimization and their application in the field of process control. Objective: To train students to apply optimization methods to find the extrema of functions in various ways. As a result, students master the formulation of optimization problems for: the synthesis of systems for optimal control of technological processes, the reduction of material balances in MES systems, etc.	5			v		v								
25	Intelligent Process Control Systems	The discipline is designed to form students' knowledge of the theoretical foundations and practical skills in building process control systems using intelligent fuzzy logic technologies. The purpose of the course is to train a specialist who is able to use in practice the theory, methods and means of synthesis of intelligent control systems. As a result of studying the discipline, the student must know the basics of the theory of fuzzy sets; the basics of creating fuzzy inference systems for control purposes.	5										v			
26	Computer modeling and programming in the MatLab environment	The discipline is designed to develop students' skills in programming and mathematical modeling in the MATLAB environment. The purpose of the course is programming and standard MATLAB functions, such packages (applications) as Control System Toolbox, Simulink, Stateflow, Deep Learning Toolbox and Fuzzy Logic Toolbox are studied. As a result of mastering the discipline, students have full tools for analysis, synthesis of control systems and development of intelligent algorithms.	6				v									
27	Programming and algorithmization	The goals and objectives of the discipline Programming and algorithmization - to teach students structural programming, to acquire knowledge and skills of algorithmization in its	5				v									

		structural version, to master all kinds of methods for solving problems implemented in a programming language, to develop logical and algorithmic thinking of students, to form the skills of competent program development, to deepen knowledge, skills and abilities to solve problems in programming and algorithmization.													
28	Technological measurements and devices	The discipline covers a wide range of methods and tools for measuring and presenting information about the state of technological processes, ensuring their high-performance, economic and safe operation. The purpose of the course is to give the future specialist the necessary amount of knowledge in studying the basic concepts, goals and principles, the ability to analyze metrological indicators and physical principles of measurement. Analyze the operation of the system based on the quality indicators of measuring instruments and systems.	5		v										
29	Training practice	The tasks of educational practice are to obtain professional primary skills and abilities, prepare students for a conscious and in-depth study of basic and general educational disciplines, and familiarize themselves with the specifics of future professional activities. Educational practice can be carried out on the basis of departments, laboratories, enterprises and institutions with various forms of ownership, the areas of activity of which are related to the future professional activities of bachelors. The student can, at his own discretion, choose a task from the proposed block of tasks, which is agreed with the head of practice. In accordance with the tasks of practice, the student performs an individual task. The student keeps records of the practice in the practice diary. At the end, students submit diaries and reports, the acceptance of final reports is carried out by a commission from among the teaching staff of the department. The final grade for the practice is defined as the assessment of the head of the practice from the department for the defense of the report. Educational practice is a mandatory type of practice	2	v				v					v	v	

		at the end of the graduating department.													
Cycle of basic disciplines Optional component															
30	Microelectronics	The principles of operation, parameters, characteristics and features of the use of semiconductor devices are considered. Designing various circuits of amplifiers of electrical signals and generators based on diodes, bipolar and field-effect transistors and testing the features of their functioning. Operational amplifiers. Differential amplifiers. Feedback. The influence of feedback on the main indicators and characteristics of amplifiers. Power amplifiers. Filter classification and composition.	5									v		
31	Microcontroller programming	Microcontroller Programming This course is intended for students to study the current state of microprocessor and microcontroller control systems. The purpose of the course is the formation of bachelor's knowledge on the principles of building digital data processing tools, the features of the organization of the work of microprocessor devices and the use of microprocessors in control systems of technical objects. As part of the course, the student will master the microcontrollers of the AVR family. AVR command system. Means of input/output in microprocessor systems. Programming of microprocessor systems.	5						v					
32	Microcontroller programming for robotic systems	This discipline is designed to study the methods of programming robotic systems. The purpose of the course: the classification of microcontrollers used in robotic systems, the structure of the microcontroller, the organization of the interruption of the microcontroller, programming languages. As a result of mastering the discipline, the student will be able to work in the environment for developing application software for RTS, connect peripheral devices to microcontrollers, perform remote control of the robot, and implement the terms of reference. build and analyze algorithms for solving typical problems.	5									v		
33	Metrology and measurements	Discipline covering a wide range of methods and tools for measuring and presenting information about	5		v									

		the state of technological processes. The purpose of the course is the necessary amount of knowledge in the study of basic concepts, goals and principles, the ability to analyze metrological indicators and physical principles of measurement. As part of the course, the student will learn to choose measuring instruments depending on the purpose and tasks of automation, to develop and design measuring instruments and measuring systems.													
34	Electrical measuring instruments	This discipline is intended for theoretical and practical training of engineers profile in the field of electrical engineering. This course deals with tasks related to the measurement of process parameters in the field of automation and control. The course content provides a classification of methods for converting and converting non-electric and electrical, specific types of measuring instruments used to measure technological parameters in various areas of production.	5							v					
35	Telecommunication networks of industrial enterprises	The discipline "Telecommunication networks of industrial enterprises" provides for the study of the main parameters and characteristics of telecommunication networks of industrial enterprises, the basics of their structural construction, taking into account modern trends in the development of communication networks, in-depth study of functional diagrams, design methods and integration of telecommunication networks and systems.	5					v							
36	Fiber optic sensors and systems	The course "Fiber Optic Sensors and Systems" discusses the principle of operation, design and parameters of modern optoelectronic and fiber optic sensors for various purposes, basic circuit and technical solutions that determine the structure and functionality of modern sensors, especially in industrial technologies.	5		v										v	
37	Actuators of automation systems	The discipline presents basic knowledge and skills in the field of actuators of automation, industrial electronics, as well as methods for studying the operating modes of electromechanical energy converters. The purpose of the course is to teach students to correctly calculate and select the actuators	5		v											

		of automation, as it is a mandatory element of the control system. As part of the course, the student will master the practical use of automation actuators: electromechanical devices, electromagnetic devices.													
38	Industrial robots and manipulator drives	In the course of studying the discipline, students must master the principle of operation, the main units and elements, advantages and disadvantages, a mathematical description of industrial robot drives. As a result of studying the discipline, students should know the operation of a pneumatic drive, a hydraulic drive and an electric drive of industrial robots. To be able to analyze the operation of control systems for drives of industrial robots.	5	v											
39	Functional units of digital automatics	The course deals with the main functional units of digital automatics: triggers, registers, counters, multiplexers, adders, control circuits, studying the principle of operation, variants of functional schemes. As a result of studying this discipline, students should: have an idea of: - about the logical and arithmetic foundations of the construction of digital devices; - about the main functional units of digital automatics; know: - principles of functioning of logical devices; be able to: choose the appropriate digital control system; be able to - choose a suitable digital control system; - get an idea of the realized functions of the digital control system.	5										v		
40	Automation elements and devices	The main purpose of studying this discipline is to teach students the ability to choose the right installation devices in automation systems. The content of the discipline deals with the fundamentals of the theory and principle of operation of actuators, the issues of correct and effective selection and calculation of actuators of automation systems. The main definitions and explanations concerning the use of setting devices in industrial automation are given.	6		v									v	
41	Elements and devices of robotics	The discipline is aimed at teaching students the basics of the theory and practice of an industrial electric drive and is aimed at developing students' skills in designing, calculating and modeling an electric drive, expanding and strengthening knowledge in mastering the methods of controlling production mechanisms	6		v									v	

		and their components in the field of modern electric drives. Basic concepts, definitions and purpose of industrial electric drives; study of the characteristics and modes of operation of various electric drives; study of various options for modern electric drives.														
Cycle of major disciplines University component																
42	Nonlinear system of the automatic control	The aim of the course is to teach students methods of modeling and analysis of nonlinear systems of automatic regulation, NSAR. The discipline studies the basics of the theory of the NSAR. Methods of mathematical description and modeling of the NSAR. Precise methods of research of stability and self-oscillation. Phase plane methods. Qualitative study of the NSAR. Lyapunov's second method. The criterion of absolute stability of V.M. Popov. Approximate methods for the study of stability and self-oscillations. Implementation of typical elements of the NSAR for process control.	5					v								
43	Linear system of automatic control	The aim of the course is to teach students the basics of the theory of linear automatic control systems, methods of mathematical description of systems, methods of stability and quality research. The content covers the following topics: Basic principles and diagrams of automatic control systems. Typical links of automatic control systems. Time and frequency characteristics of links and systems. Rules for transforming structural schemes. Algebraic and frequency methods of analyzing the stability of linear automatic control systems. Direct and indirect methods of assessing the quality of linear automatic control systems.	5					v								
44	Neural Network Automation Technologies	The purpose of the discipline is to study and master the skills of creating intelligent control systems based on expert systems and neural networks. The objectives of the discipline is to master the theoretical foundations and acquire practical skills in the field of creating control systems using methods of artificial intelligence. This course is designed for students to create control systems based on the methods of artificial intelligence is preceded by a description and	4										v			

		study based on the application of knowledge models that reflect the different properties and patterns of functioning of the control object.													
45	Industrial internship I	In order to consolidate and deepen the theoretical knowledge gained by students in the learning process, the acquisition of practical skills, competencies and professional experience in the educational program being taught, as well as the development of best practices, a bachelor's internship is carried out. Students have practical training at enterprises, working directly at the workplaces of students, performing specific production tasks, consolidating theoretical knowledge. In the process of practice, practice leaders and appointed specialists at the workplace provide students with the necessary assistance and monitor (control) the process of internship in terms of meeting deadlines and content. The student keeps personal records of the practice in the practice diary. At the end, students submit diaries and reports, the acceptance of final reports is carried out by a commission from among the teaching staff of the department. The final grade for the practice is defined as the assessment of the head of the practice from the enterprise and the assessment of the head of the practice from the department for the defense of the report. The result of the satisfaction of students, teaching staff and employers with places, conditions and content of practices, as well as the level of students and teachers is the opinion and feedback from organizations that provide bases for internships. Industrial practice is a mandatory type of practice at the end of the course conducted by the graduating department.	2	V				V					V	V	
46	Industrial internship II	In order to consolidate and deepen the theoretical knowledge gained by students in the learning process, the acquisition of practical skills, competencies and professional experience in the educational program being taught, as well as the development of best practices, a bachelor's internship	3	V				V					V	V	

		is carried out. Students have practical training at enterprises, working directly at the workplaces of students, performing specific production tasks, consolidating theoretical knowledge. In the process of practice, practice leaders and appointed specialists at the workplace provide students with the necessary assistance and monitor (control) the process of internship in terms of meeting deadlines and content. The student keeps personal records of the practice in the practice diary. At the end, students submit diaries and reports, the acceptance of final reports is carried out by a commission from among the teaching staff of the department. The final grade for the practice is defined as the assessment of the head of the practice from the enterprise and the assessment of the head of the practice from the department for the defense of the report. The result of the satisfaction of students, teaching staff and employers with places, conditions and content of practices, as well as the level of students and teachers is the opinion and feedback from organizations that provide bases for internships. Industrial practice is a mandatory type of practice at the end of the course conducted by the graduating department.														
Cycle of major disciplines Selectable Component																
47	Microprocessor based systems in the control systems	This course is designed for students to build distributed and concentrated control systems, the principles of building industrial controllers, programming tools and programming languages of industrial controllers. The following sections are studied: the principles of organization and application of different classes of microprocessor systems, the acquisition of programming skills of embedded systems, at the stages of system, structural and logical design a certain place is given to the design of hardware and software of microprocessor systems, methodology of selection of microprocessor sets, features of development and debugging of	6										v		

		hardware and software systems.													
48	Capstone Research Project 1	The Capstone Project is a project-based course that final year students take to demonstrate what they have learned from their first year to the final year of the 6B07103 - Automation and Robotics curriculum. Applying it in a specific idea to create something new and solve a specific problem. The Capstone Project aims to improve the quality of student graduate work through the formation and development of students' critical thinking skills, as well as planning, organizing and conducting scientific research.	6	v				v					v	v	
49	Capstone research project 2	The Capstone Project 2 course is a continuation of the Capstone Project 1 course. The course "Capstone Project 2" is a self-made development related to the solution of theoretical issues and experimental research or to the solution of applied problems that are part of the research work carried out by the department or enterprise.	5	v				v					v	v	
50	SCADA system	This course is intended for students to study the principles of building software and hardware complexes (STC), choosing hardware, learning the principles of building and choosing SCADA systems when solving problems of automation of technological processes and industries. As a result of mastering the discipline, the student will be able to develop a justification and choice of automated tasks, to make the most appropriate choice of hardware and software. The study of the SCADA-system gives a visual representation of the process and provides, as a rule, a graphical interface to the operator for monitoring and control.	5								v				
51	Theory and practice of project management	The discipline is aimed at studying the general trends of project management in market conditions in order to increase productivity in the professional industry. The essence, concept, composition, tasks and problems of management. Study of the scientific methodology of project management. The concept of organization, the external and internal environment of the team, communication. Requirements for project management. The role of decision-making in project management. The concept of anti-crisis	5	v										v	

		programs in the performance of managerial functions. The concept of management culture and professional etiquette.													
52	Industrial robot control systems	The discipline studies industrial programming languages for controllers STL, LAD, FBD and microprocessor programming languages C, Python. Methods for creating variables, working with logical, mathematical operators. Processing of discrete and analog signals and interfaces SPI, I2C, CAN, UART. Implementation of PID/PI/PD controllers.	5						v						
53	Robotics automation of production processes	The disciplines "Robotization of production processes" are aimed at preparing students for independent theoretical, experimental, design and implementation work in the field of robotization of industries in various industries. Issues related to the appointment, the device, and the process of functioning of robots and robotic technological complexes used in various technological processes in engineering are considered. The objectives of the study of discipline is the assimilation of theoretical foundations and the acquisition of practical skills necessary for the development of robotic systems and complexes for the robotization of technological operations and processes in various fields of engineering. As a result of studying the discipline, the trainee must know: the device of robotic systems and complexes for various purposes used in various industries and industries; content and work on the creation of robotic technological complexes in various industries. To be able: to set and solve scientific and practical tasks on robotization, to develop systems and complexes of robotization.	5	v										v	
54	Industrial regulators	The aim and objectives of the course is to give students the skills to work with industrial regulators, familiarization with the features of real regulators, mastering the knowledge and skills necessary to configure and implement industrial regulators. The course includes sections. Methods of tuning industrial regulators. Features of real industrial regulators, noise and integral saturation. Discrete form of industrial regulators. Modifications of	5					v							

		regulators, types and structures of industrial regulators, methods of their tuning.														
55	Design of robotization systems	The discipline examines the types and definition of robots, areas of knowledge for robotic design. Design systems. Modeling tools in Computer Aided Design System. Elements of robotic designs. Actuating devices of robots. Types of control of robotic systems. Sensors. Features of the design of control system of intelligent robots. The purpose of the course is to give students the formation of knowledge, skills and abilities necessary for engineering work in the field of designing systems of automation and robotization of industrial objects.	5								v				
56	Design of automation systems	The course is designed to instill in students the methods of designing automated control systems. The student will master practical skills and abilities in the field of automation systems design; get acquainted with the trends in the development of science and technology and their impact on automation; study regulatory documents, state standards for the design of automation systems, the essence of a systematic approach to design, requirements for modern control systems; the structure and purpose of the state system of devices; various structural and functional schemes of control systems; basic algorithms that ensure the operation of typical industrial regulators; technical means of automation systems; modern technical and software tools of computer technology.	5								v				
57	Reliability of technical systems	The discipline "reliability of technical systems" covers the following main areas. Modern scientific ideas in the development of safety assessment of technical systems. Theory of reliability of devices, machines and structures. Reliability indicators, mathematical models of reliability and viability. Mathematical expectations of the number of failures and the application of the theory of reliability and viability to the design conditions of machines and structures. The theory of tolerance. Models of damage accumulation. Mechanics of fatigue disorder. Forecasting at the design stage. Control of	5									v			

		breakdowns of machines and mechanisms. Maintenance planning.														
58	Reliability of automation systems	The purpose of studying the discipline is to study methods for assessing the reliability of automated systems at the design stage, to study methods for assessing the reliability of systems in operation, to apply probability theory to predict and prevent equipment failures, to study methods for diagnosing existing equipment. The course examines the issues of determining reliability indicators, the physical nature and causes of failures, their types and classification. Special attention is paid to the issues of monitoring the operability of automated systems, troubleshooting and ensuring operational reliability.	5										v			
59	Installation and adjustment of robotic systems	The discipline studies general information about the organization and conduct of installation works of robotic systems. Installation and commissioning and testing of mechatronic systems. Principle structural diagrams, automation diagrams, connection and wiring diagrams of mechatronic systems, control algorithms of mechatronic systems. Safety measures during installation and commissioning of mechatronic systems. Types of technical documentation during installation works. The aim of the course is to form a comprehensive knowledge of the processes and relationships between mechanical and electrical elements in microprocessor-controlled electromechanical systems.	4												v	
60	Installation and adjustment of electrical devices of control systems	This discipline is designed to study the implementation of installation work, training in the organization and methods of installation and adjustment of automation control equipment. The purpose of the course is to give students the necessary amount of theoretical knowledge on the technology of installation, adjustment and safe operation of measuring and control instruments. As a result of mastering the discipline, the student must teach modern methods of installation and adjustment of automation systems, to adjust automation systems.	4												v	
61	Automation of typical technological processes and	This discipline is designed to study the methodology for analyzing typical technological objects as control	5												v	

	productions	objects, as well as setting control tasks, the structure of modern process control systems, their varieties and composition. The purpose of studying the discipline is to give students a fairly complete understanding of the concepts of Automation of process control systems. As a result of mastering the discipline, the student must know the basic constructions and architecture of control systems, be able to reasonably choose technical means of automation.														
62	Internet of things (IoT) technologies	The discipline Technology of Internet of Things is designed to familiarize students with the principles of construction and operation of digital devices for further application of the acquired knowledge in the development and design of automated systems based on IoT. By the end of the training students will know: - rules of safe work and requirements for the organization of the workplace; - basics of programming microcontrollers for controlled technical systems; - basics of sensors application; - basics of the creation of controlled systems. By the end of the training the students will be able to: - observe the rules of safe work; - program microcontrollers for controlled technical systems; - select, connect and configure sensors; - develop controlled systems on the Internet of Things technology.	6				v						v		
63	Local control systems	The aim of the course is to train specialists possessing the theoretical apparatus underlying the theory of local control systems (LCS). Course objectives - the study of modern methods of local control systems analysis. The course includes sections of the theory of automatic control associated with the tasks of analysis and synthesis of local control systems. Competencies, acquired during the course - Theoretical skills in the analysis and design of LSCs; - practical skills in the calculation of typical regulators of automation systems of technological processes.	4					v							
64	Typical automation system regulators	The aim of the course is to study the methods, means of tuning and practical implementation of typical regulators of automation systems. Course objectives	4					v							

		- mastering the knowledge necessary for empirical and analytical tuning of typical regulators of automation systems. The course includes sections: typical laws of regulation, empirical and analytical methods of tuning of typical automation controllers, types and structures of typical controllers. By the end of the course students will be able to solve applied problems in the synthesis of various automation systems. They will acquire the skills to configure typical controllers of automation systems.													

5. Curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVED

CURRICULUM
of Educational Program on enrollment for 2023-2024 academic year

Educational program 6B07103 - "Automation and robotization"
Group of educational programs B063 - "Electrical engineering and automation"

Form of study: full-time | Duration of study: 4 years | Academic degree: Bachelor of Engineering and Technology

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom in academic hr/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters: I course 1 semester	I course 2 semester	II course 3 semester	II course 4 semester	III course 5 semester	III course 6 semester	IV course 7 semester	IV course 8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG 103	English language	GED, RC	10	300	0/0/6	210	E	5	5						
LNG 104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5						
M-2. Module of physical training															
KFK 101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Diff.credit	2	2	2	2				
M-3. Module of information technology															
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E			5					
M-4. Module of socio-cultural development															
HUM 137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE	5							
HUM 132	Philosophy	GED, RC	5	150	1/0/2	105	E			5					
HUM 128	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E			3					
HUM 134	Socio-political knowledge module (culturology, psychology)	GED, RC	5	150	2/0/1	150	E				5				
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM 136	Fundamentals of anti-corruption culture and law	GED, CCH	5	150	2/0/1	150	E				5				
ELC577	Fundamentals of Scientific Research Methods														
MNG 489	Fundamentals of Economics and Entrepreneurship														
CHE 656	Ecology and life safety														
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT 101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY 111	Physics I	BD, UC	5	150	1/1/1	105	E	5							
MAT 102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
PHY 112	Physics II	BD, UC	5	150	1/1/1	105	E		5						
M-7. Module of basic and general technical training															
GEN 429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E		5						
AUT426	Introduction to the specialty and engineering ethics	BD, UC	4	120	2/0/1	75	E	4							
ELC541	Theoretical Foundations of Electrical Engineering	BD, UC	5	150	2/1/0	90	E			5					
RGR502	Basics of Electronics	BD, UC	5	150	1/1/1	90	E				5				
AUT430	Power electronics automation	BD, UC	4	120	2/1/0	60	E						4		
ELC508	Microelectronics	BD, CCH	5	150	2/1/0	90	E					5			
AUT447	Functional units of digital automatics				2/1/0										
CHE198	Process automation facilities	BD, UC	5	150	2/0/1	105	E					5			
AUT431	Technology of robotic production	BD, UC	6	180	2/0/2	120	E							6	
M-8. Module of theoretical foundations of management															
AUT413	Mathematical Foundations of control theory	BD, UC	5	150	2/0/1	105	E				5				
AUT415	Optimization methods	BD, UC	5	150	1/1/1	90	E					5			
AUT406	Intelligent process control systems	BD, UC	6	150	1/2/0	75	E							5	
AUT416	Nonlinear system of the automatic control	PD, UC	5	150	1/1/1	90	E						5		
AUT411	Linear System of Automatic Control	PD, UC	5	150	1/1/1	90	E					5			
AUT440	Local control systems	PD, CCH	4	120	1/1/1	60	E								
AUT449	Typical automation system regulators				1/1/1								4		
M-9. Module of software and hardware automation															
AUT429	Computer modeling and programming in MatLab	BD, UC	6	180	2/2/0	90	E			6					
AUT428	Programming and algorithmization	BD, UC	5	150	2/1/0	90	E			5					
AUT184	Microcontroller programming	BD, CCH	5	150	2/1/0	90	E								
AUT183	Microcontroller programming for robotic systems				2/1/0								5		
AUT436	Neural network automation technologies	PD, UC	4	120	2/1/0	60	E						4		
AUT450	Automation elements and devices	BD, CCH	6	180	2/1/1	105	E								
AUT451	Elements and devices of robotics				2/1/1									6	

M-10. Module of control and measuring devices																
AUT351	Metrology and measurement	BD, CCH	5	150	2/1/0	90	E				5					
AUT393	Electrical measuring instruments				1/1/1											
AUT430	Technological measurements and devices	BD, UC	5	150	1/1/1	90	E					5				
ELC440	Telecommunication networks of industrial enterprises	BD, CCH	5	150	2/0/1	105	E					5				
ELC425	Fiber optic sensors and systems				2/1/0	90										
M-11. Module for development and design of automation and control systems																
AUT404	Reliability of automation systems	PD, CCH	5	150	2/0/1	105	E							5		
AUT405	Reliability of technical systems				2/0/1											
AUT162	Industrial Regulators	PD, CCH	5	150	2/1/0	90	E							5		
AUT367	Robotic automation of production processes				1/1/1	90										
NSE185	Theory and practice of project management				2/0/1	105										
AUT419	Design of automation systems	PD, CCH	5	150	2/0/1	105	E									5
AUT173	Design of robotization systems				2/0/1											
AUT440	Microprocessor-based systems in the control systems	PD, CCH	6	180	2/2/0	90	E							6		
AUT444	Capstone research project 1				0/0/4	120										
AUT452	Internet of Things (IoT) technologies				2/1/1	105										
AUT402	SCADA-system	PD, CCH	5	150	2/1/0	90	E									5
AUT445	Capstone research project 2				0/0/3	105										
M-12. Module of professional disciplines																
AUT409	Actuators of Automation Systems	BD, CCH	5	150	2/1/0	90	E						5			
AUT188	Industrial robots and manipulator drives				1/1/1											
AUT438	Installation and adjustment of electrical devices of control systems	PD, CCH	4	120	1/1/1	90	E									4
AUT439	Installation and adjustment of robotic systems				2/0/1	105										
AUT368	Automation of typical technological processes and production	PD, CCH	5	150	1/1/1	90	E									5
AUT186	Industrial robot control systems				2/1/0											
M-13. Practice-oriented module																
AAP101	Training Practice	BD, UC	2						2							
AAP102	Industrial internship I	PD, UC	2								2					
GEN501	Industrial internship II	PD, UC	3										3			
M-14. Module of final attestation																
ECA108	Final examination	FA	8													8
M-15. Module of additional types of training																
AAP503	Military affairs	ATT	0													
Total based on UNIVERSITY:								31	29	31	29	30	30	33	27	
								60		60		60		60		

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	51		5	56
BD	Cycle of basic disciplines		87	31	176
PD	Cycle of profile disciplines		19	39	
	Total for theoretical training	*51*	*106*	*75*	*232*
FA	final attestation	8			8
	TOTAL:	59	106	75	240

Decision of the Academic Council of Kazatu named after K.Satpayev. Protocol № 5 "24" november 2022 y.

Decision of the Educational and Methodological Council of Kazatu named after K.Satpayev. Protocol № 3 "17" november 2022 y.

Decision of the Academic Council of the Institute Ab.TT Protocol № 2 от "20" 09 2022 г.

Vice-Rector for Academic Affairs	B.A. Zhanbirov
Director of the Institute of AaIT	B.K. Urkenbayeva
Head of the Department of AaC	N.U. Abdyazov
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)