Institute of Automation and Information Technology
Department "Robotics and Engineering Tools of Automation"

EDUCATIONAL PROGRAM
6B07113 Robotics and Mechatronics

Code and classification of the field of education:
6B07 Engineering, manufacturing and construction industries
Code and classification of training directions:
6B071 Engineering and engineering trades
Group of educational programs:
B063 Electrical engineering and automation
Level based on NQF: **6**
Level based on IQF: **6**
Study period: **4 year**
Amount of credits: **240**

Almaty 2022

Educational program 6B07113 Robotics and Mechatronics was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes #13 dated 28.04.2022

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council

Minutes #7 dated 26.04.2022

Educational program 6B07113 Robotics and Mechatronics was developed by Academic committee based on direction 6B071 Engineering and engineering trades.

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Baktybaev Murat Kyrgyzbaevich	Candidate of Physical and Mathematical Sciences	Associate Professor	Department of «Robotics and Engineering Tools of Automation», K.I. Satbayev KazNRTU	
Teaching staff:				
Ozhikenov Kassymbek Adilbekovich	Candidate of Technical Sciences	Professor, Head of the Department	Department of «Robotics and Engineering Tools of Automation», K.I. Satbayev KazNRTU	
Employers:				
Dzhumagulov Arystanbek Kuyzembaevich	-	General Director	LLP «MEDREMZAVOD HOLDING»	
Akzhanov Janat Koishibaevich	-	Director	LLP «SAIMAN Corporation»	
Students				
Muratov Dias Muratovich	-	3rd year student	Department of «Robotics and Engineering Tools of Automation», K.I. Satbayev KazNRTU	

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List of abbreviations and designations

EP - Educational program
GEP - general education disciplines
BD - basic disciplines
PD - profile disciplines
MSHE RK - Ministry of Science and Higher Education of the Republic of Kazakhstan
SAC - state attestation commission
ECTS - European Credit Transfer and Accumulation System
GC – General cultural competences
GPC - General professional competencies
PC - Professional competence
EO - educational outcomes
FA – final attestation

1. Description of educational program

The professional activities of the graduates of the program are directed to the field of robotics and mechatronics.

Educational program «Robotics and mechatronics» is aimed at training professional bachelors in the field of design and construction of robots, robotic and mechatronic systems for industrial and non-industrial purposes.

The objects of professional activity of graduates who have completed the undergraduate program are robotic and mechatronic systems, including information and sensory, Executive and control units, their mathematical, algorithmic and software methods and tools for design, modeling, experimental studies, debugging and exploitation, research and production testing of robotic and mechatronic systems having different applications.

Educational program "Robotics and mechatronics" contains a complete list of academic disciplines, grouped in cycles: general education disciplines (GED), basic disciplines (BD) and profile disciplines (PD) as mandatory components, and components for selection, indicating the complexity of each subject in academic credits and hours established by the State obligatory standards of higher and postgraduate education, approved by order of MSHE RK №2 dated July 20, 2022.

The disciplines of the mandatory component of the GED cycle are aimed at forming the worldview, civic and moral positions of a future specialist who is competitive on the basis of knowledge of information and communication technologies, building communication programs in the state, Russian and foreign languages, focusing on a healthy lifestyle, self-improvement and professional success. The BD cycle includes studying academic subjects and passing professional practice. The PD cycle includes academic disciplines and types of professional practices. The programs of disciplines and modules of the BD and PD cycles are interdisciplinary and multidisciplinary in nature, providing training at the junction of a number of areas of knowledge.

Final certification is carried out in the form of writing and defending a thesis (project) or preparing and passing a comprehensive exam.

The requirements for the level of training of students are determined based on the Dublin descriptors of the first level of higher education (bachelor's degree) and reflect the development of competence, expressed as outcomes of learning. Learning outcomes are formed both at the level of the entire educational program of higher education, and at the level of individual modules or academic disciplines.

Description compulsory standard requirements for graduation and assignment of the academic degree bachelor: on the volume of the educational program of bachelor degree is 240 credits, regardless of the form of education, applied educational technologies, the implementation of bachelor programs using a network form of realization of the program of bachelor in the individual curriculum, including accelerated learning.

Special requirements for University graduation in this program: Students who have passed the final certification, and who have confirmed the assimilation of the professional curriculum in the EP "Robotics and mechatronics", the decision

of the SAC confers the academic degree "Bachelor of engineering and technology" in the educational programRobotics and mechatronics and a state-issued diploma with an Appendix is issued.

Issuance of a state-issued diploma with an Appendix is carried out on the basis of an order of the head of the University on graduation.

The diploma Supplement is filled out on the basis of a certificate of completion of the student's (student's) individual curriculum in accordance with the received grades in all disciplines in the amount provided for by the state mandatory standard of education and the working curriculum, completed course papers (projects), types of practices and the results of final certification.

In the diploma Supplement, the latest grades for each academic discipline are recorded according to the point-rating letter system of knowledge assessments, indicating its volume in credits and in the ECTS scale.

2. Purpose and objectives of educational program

Purpose of EP: The purpose of the educational program is to train highly qualified, competitive and in-demand specialists in the field of robotics and mechatronics in the labor market, capable of performing design, production, technical, organizational work in professional activities

Tasks of EP: As a result of the training bachelor of EP "Robotics and mechatronics" should receive all the necessary knowledge and skills for ensuring quality implementation of functional responsibilities in their chosen specialty, and to acquire socio-humanitarian, economic, administrative, scientific and technical competencies that serve as the Foundation for providing graduate mobility on the professional labor market and readiness to continue their education in higher or further education.

Competencies at the end of studing

Generalcultural competences (GC)	
GC 1	The ability to communicate in oral and written forms in the state, Russian and foreign languages for solving problems of interpersonal and intercultural interaction
GC 2	Understanding and practical use of the norms of a healthy lifestyle, including issues of prevention, the ability to use physical culture to optimize performance
GC 3	The ability to analyze the main stages and patterns of the historical development of society for the formation of civic position
GC 4	Ability to use the foundations of philosophical knowledge to form a worldview
GC 5	The ability to critically use the methods of modern science in practice
GC 6	Awareness of the need and the acquisition of the ability to independently study and improve their qualifications throughout their working life
GC 7	Knowledge and understanding of professional ethical standards, mastery of professional communication techniques
GC 8	Ability to work in a team, tolerantly perceiving social, ethnic, confessional and cultural differences
GC 9	Ability to use the basics of economic knowledge in various fields of activity
General professional competencies (GPC)	
GPC 1	Knowledge of design methods for robotic and mechatronic systems, their individual subsystems and modules
GPC 2	Possession of modern software products for solving problems of system design, design of mechanical and mechatronic modules, control and information processing
GPC 3	Knowledge of mathematical models of robots, robotic and mechatronic systems, their individual subsystems and modules, carrying out their research using mathematical modeling, using both special and universal software tools, in order to substantiate the theoretical and design decisions
GPC 4	Understanding the physical processes and phenomena underlying the principles of operation of devices, equipment and systems
GPC 5	Knowledge of standards, methodological and regulatory materials accompanying the operation, installation and adjustment of modern mechatronic systems with digital control
Professional competence (PC)	
PC -1	Collection and analysis of scientific and technical information, taking into account modern trends in the development and use of the achievements of science, technology and technology in professional activities

PC -2	Assessment of the economic efficiency of the implementation of projected robotic and mechatronic systems, their individual modules and subsystems
PC -3	Application of modern software products and the latest technologies for solving and managing interdisciplinary engineering problems in various fields of science and technology
PC -4	Evaluation of the surrounding reality on the basis of worldview positions formed by knowledge of the foundations of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical knowledge
PC -5	Calculation and design of individual blocks and devices of robotic and mechatronic systems, control, information-sensor and executive subsystems and mechatronic modules in accordance with the terms of reference
PC -6	Planning tests of modules and subsystems of robotic and mechatronic systems, participation in the organization and conduct of experiments at existing facilities and experimental models, processing the results of experimental studies using modern information technologies
PC -7	Monitoring the compliance of technical documentation of developed projects with standards and technological conditions
PC -8	Implementation of the results of theoretical developments in the production of robotic and mechatronic systems, their subsystems and individual modules
PC -9	Organization of work on operation, installation and commissioning of modern mechatronic systems
PC -10	Organization of the activities of the production team, making organizational and managerial decisions in the context of different opinions and assessing the consequences of decisions made

3. Requirements for evaluating the educational program learning outcomes

EO1 - Demonstrate knowledge of the branches of higher mathematics, physics and other natural sciences and apply them to solve problems that have arisen in the course of professional activity.

EO2 – Apply modern software products and the latest technologies to solve and manage interdisciplinary engineering problems in various fields of science and technology.

EO3 – Research in the field of development of new samples and improvement of existing mechatronic and robotic systems, search for new ways of information management and processing.

EO4 – Collect and analyze scientific and technical information, taking into account current trends in the development and use of achievements of science, technology and technology in professional activities.

EO5 – To determine the safety, environmental friendliness and economic efficiency of the implementation of the projected robotic and mechatronic systems, their individual modules and subsystems.

EO6 – Calculate and design individual blocks and devices of robotic and mechatronic systems, intelligent control, information-sensor and executive subsystems and mechatronic modules, in accordance with the terms of reference.

EO7 – Plan tests of modules and subsystems of robotic and mechatronic systems, organize and conduct experiments on existing objects and experimental models, processing the results of experimental research, using modern information technologies.

EO8 – To assess the compliance of the technical documentation of the developed projects with standards and technological conditions.

EO9 – Organize the operation, installation and commissioning of modern mechatronic systems.

EO10 - Organize the activities of the team, make organizational and managerial decisions in the context of different opinions and assess the consequences of the decisions taken.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	6B07 Manufacturing and processing industries
2	Code and classification of training directions	6B071 Engineering and engineering trades
3	Educational program group	B063 Electrical engineering and automation
4	Educational program name	6B07113 Robotics and Mechatronics
5	Short description of educational program	Educational program «Robotics and mechatronics» is aimed at training professional bachelors in the field of design and construction of robots, robotic and mechatronic systems for industrial and non-industrial purposes.
6	Purpose of EP	The purpose of the educational program is to train highly qualified, competitive and in-demand specialists in the field of robotics and mechatronics in the labor market, capable of performing design, production, technical, organizational work in professional activities
7	Type of EP	New
8	The level based on NQF	6
9	The level based on IQF	6
10	Distinctive features of EP	-
11	List of competencies of educational program	providing a wide range of theoretical and practical knowledge in the professional field; the ability to develop methodological and regulatory documents, technical documentation, as well as the implementation of measures to implement the developed projects and programs; the ability to make decisions based on the results of calculations for projects and the results of the technical-economic and functional-cost analysis of the effectiveness of the designed mechatronic systems; master the organization of work on operation, installation and adjustment of modern machines and equipment
12	Learning outcomes of educational program	EO1-EO10
13	Education form	full-time
14	Period of training	4 year
15	Amount of credits	240
16	Languages of instruction	russian, kazakh
17	Academic degree awarded	«Bachelor of Engineering and Technology in the educational program «6B07113 Robotics and Mechatronics»
18	Developer(s) and authors	Ozhikenov K.A., Tasbolatova L.T.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)									
				EO1	EO2	EO3	EO4	EO5	EO6	EO7	EO8	EO9	EO10
Cycle of general education disciplines Component of choice													
1.	Fundamentals of anti-corruption culture	The discipline studies the essence, causes, causes of sustainable development of corruption from both historical and modern points of view. Examines the prerequisites and impacts for the development of an anti-corruption culture. Studies the development of anti-corruption on the basis of social, economic, legal, cultural, moral and ethical norms. Studies the problems of the formation of an anti-corruption culture based on the relationship with various types of social relations and various manifestations.	5									v	v
2.	Fundamentals of Entrepreneurship and Leadership	The discipline studies the basics of entrepreneurship and leadership from the point of view of science and law; features, problematic aspects and prospects of development; theory and practice of entrepreneurship as a system of economic, organizational and legal relations of business structures; readiness of entrepreneurs for innovative receptivity. The discipline reveals the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of an entrepreneur, theoretical and practical business planning and economic expertise of business ideas, as well as risk analysis of innovative development, introduction of new technologies and technological solutions.	5									v	v
3.	Ecology and life safety	Purpose: formation of concepts and ideas about the inseparable unity of effective professional activity with the requirements of human safety and security and environmental protection. The issues of ecology, life safety in the conditions of labor activity are considered. In the course of problematic seminars, sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems are considered; life safety in the technosphere; natural and man-made emergencies.The discipline studies the tasks of ecology as a science, types (autecology, population and social ecology), ecological terms, laws of functioning of natural systems and aspects of environmental safety in working conditions. Environmental monitoring and management in The discipline studies the tasks of ecology as a science, types (autecology, population and social ecology), ecological terms, laws of functioning of natural systems and aspects of environmental safety in working conditions. Environmental monitoring 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	5					v					

		emergencies.											
Cycle of basic disciplines University component													
4.	Engineering and computer graphics	The course develops the following skills in students: to depict all kinds of combinations of geometric shapes on a plane, to conduct research and their measurements, allowing for image transformations; create technical drawings, which are the main and reliable means of information, providing a link between the designer and the designer, technologist, builder, in AutoCAD.	5						v				
5.	Mathematics I	The course is based on the study of mathematical analysis in a volume that allows you to study elementary functions and solve the simplest geometric, physical and other applied problems. The main focus is on differential and integral calculus. The course sections include the differential calculus of functions of one variable, the derivative and differentials, the study of the behavior of functions, complex numbers, and polynomials. Indefinite integrals, their properties and methods of calculation. Certain integrals and their applications. Improper integrals.	5	v				v					
6.	Mathematics II	The discipline is a continuation of Mathematics 1. The course sections include elements of linear algebra and analytical geometry. The main issues of linear algebra are considered: linear and self-adjoint operators, quadratic forms, linear programming. Differential calculus of a function of several variables and its applications. Multiple integrals. The theory of determinants and matrices, linear systems of equations, as well as elements of vector algebra. The elements of analytical geometry on the plane and in space are included.	5	v		v			v				
7.	Mathematics III	The discipline is an extension of Mathematics 2. The course sections include: theory of numerical series; theory of functional series; Fourier series; elements of probability theory and mathematical statistics. Special attention is paid to solving problems in all sections of series theory; finding the probability of events; calculating the numerical characteristics of random variables; using statistical methods for processing experimental data.	5	v						v			
8.	Physics I	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical research; the influence of physics as a science on the development of technology; the relationship of physics with other sciences and its role in solving scientific and technical problems of the specialty. The course covers the following sections: 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's equations.	5	v			v						
9.	General chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental laws of chemical thermodynamics and kinetics; quantum mechanical theory of atomic structure and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. The structure	4	v									

		of matter and the chemistry of elements.											
10	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						v			
11	Fundamentals of Electromechanics and electronics	Formation of students' knowledge of the basics of electromechanics and 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.	6	v									
12	Electronics	The course is aimed at developing students' knowledge of the basics of electronics, methods of calculation and design of electronic devices. In the process of studying the course, the student will master the principles of the physical foundations of operation and devices of semiconductor devices, study their characteristics and indications, as well as the basic principles of constructing analog electronic circuits, signal generators, the principles of operation of integrated circuits, the functions and construction of integrated logic elements, and study methods for the synthesis of logic devices combination and chain types	5	v									
13	Integrated and microprocessor circuitry	The discipline is aimed at familiarizing students with the basics of digital integrated circuitry and their practical application in robotics, getting an idea of the development of integrated digital circuitry, architecture and programming of typical microprocessor systems, methods of automated modeling and design of electronic circuits.	5				v						
14	Robot mechanics	The discipline studies the main types of mechanisms of robots and manipulators: articulated-lever, cam and gear mechanisms. The structural, kinematic and dynamic analysis and synthesis of various mechanisms of robots and manipulators, and their kinematic and dynamic properties are considered. Practical methods for solving problems of analysis and synthesis of mechanisms of robots and manipulators are studied.	5			v			v				
15	Mechanics of manipulators	The purpose of the discipline is to study by students the features of designing and calculating manipulators of industrial robots and technological equipment, modern designs of robotic complexes, their location and structure, characteristics and requirements, conditions for the use of various manipulators in production. The main task of students is to acquire the necessary set of knowledge on modern production automation tools, be able to determine the optimal combination of the main technical and economic indicators, instill the necessary practical skills in the study, calculation and assembly of industrial robots and manipulators.	5					v	v				

16	Mechanics of controlled machines	The course is aimed at studying methods for controlling dynamic systems and estimating their state; mastering the methods of designing optimal control systems; application of the studied methods and algorithms for solving problems related to the control of mechatronic machines; study of various drive elements and structures in the overall system for constructing controlled mechatronic machines.	5			v			v				
17	Basics of automation	The study of the general principles of building automation systems and automatic control, methods for selecting and calculating elements and automation systems. Acquaintance with the technical means of automatic systems and control systems, mastering the methods of practical calculation of the systems of automatic regulation and control, familiarity with the current state of technical means of automation.	5	v		v							
18	Fundamentals of information and measurement technologies	The purpose of the discipline "Fundamentals of information and measurement technologies" is to study general information about the measurement of physical quantities, methods and means of measurement, measurement and information systems. The study of the main methods and means of measuring electrical, magnetic and non-electrical quantities, methods for evaluating the accuracy of measurement results, familiarization of students with modern measuring technologies and their application.	5	v									
19	Fundamentals of research methodology	The discipline "Fundamentals of research methodology" is aimed at studying the theory of methodology and methods of scientific and pedagogical research, the use of this knowledge in the specific research work of students. To acquaint students with the basic concepts of the general methodology of cognition of objective reality; to study the features of the subject of scientific research. When conducting training sessions on the discipline, the development of students' skills of teamwork, interpersonal communication is ensured.	5	v		v							
Cycle of basic disciplines Component of choice														
20	Industrial Robotics	The discipline is aimed at mastering disciplinary competencies in the use of information technology, technology, application software in the construction and diagnosis of industrial robots and robotic systems, including the use of modern methods for developing energy-efficient technologies and controls; to study the structure and arrangement of industrial robots, the basic principles of control implemented in robot drives, the principles of designing and assessing the state of industrial robots.	5			v	v						
21	Service robotics	The discipline is aimed at familiarizing students with the history of development, purpose, general principles of operation of devices and the scope of application of service and other types of non-industrial mobile robots. To form an objective understanding of the relationship "man – machine" at the level of modern technology and the principles of its development in the future. They study the features of kinematics and dynamics of service and non-industrial mobile robots.	5			v	v						
22	Phytomorphic and anthropomorphic robotics	The course is aimed at the formation of basic knowledge about biomorphic and anthropomorphic robotic systems, their applications and design designs, as well as	5	v		v							

		training in methods of calculating the parameters of manipulators, the acquisition by students of the skills of calculating kinematic and dynamic variables of movement of manipulation systems; knowledge about robotic devices of bionic and anthropomorphic design designs.												
23	Autonomous mobile robots	In the process of studying the discipline "Autonomous mobile robots" a student forms a knowledge base on the basics of organizing the design process, on the principles of parallelization of design work, on how to achieve optimal technical and economic parameters of the developed products of mobile robotic systems.	5					v	v					
24	Programming for microcontrollers	The discipline is aimed at studying the methods of programming microcontrollers and acquiring skills in the practical application of microcontrollers in modern information-measuring and control systems; formation of programming skills for microcontrollers for solving various problems, using analog-to-digital and digital-to-analog converters.	5		v				v					
25	Programming in a high-level language	The discipline studies the basic principles of programming in high-level languages and their application in solving applied problems. The study of the discipline should contribute to the formation of the foundations of scientific thinking among students, including: understanding the principles of building complex systems using a high-level programming language; the ability to evaluate the effectiveness of various technologies and principles for solving applied problems.	5		v									
26	Microprocessor control devices of robots	The discipline is aimed at studying structural diagrams of microprocessor systems in mechatronics and robotics, the basics for developing hardware for microprocessor devices and controlling robots; acquisition of skills in building control devices for various objects of mechatronic and robotic systems.	4			v			v					
27	Microcontroller control systems	The discipline is aimed at studying the basic principles of building microprocessor systems and modern architectures of microcontrollers; mastering methods and tools for the development of microcontroller systems for collecting and processing information; acquisition of skills in managing various sensors and solving the problem of microprocessor control.	4	v		v								
28	Robot management	Basic concepts of mechatronics and robotics, device robots, principles of design, design and management of robotic systems, principles and methodological bases for the construction of mechatronic devices, modules, systems, device and principle of operation of industrial robots, manipulators, tongs PR, individual modules PR, classification of mechatronic modules, robots and manipulators, their main technical characteristics.	6			v			v					
29	Control and dynamic systems	The discipline is aimed at the formation of competencies necessary for the acquisition of knowledge and skills of construction, as well as qualitative and quantitative research of mathematical models of controlled complex dynamic systems operating in continuous or discrete time, as well as evaluation of raw materials and data for the development of mathematical models of a real process or phenomenon.	6			v			v					
30	Statistical Methods in Engineering Research	The discipline is aimed at studying the basic methods of modeling processes and systems in solving problems of processing and interpretation of experimental data and	5						v	v				

		problems of system engineering and circuit design, the formation of logical and algorithmic thinking of students, allowing the use of statistical methods in engineering research.											
31	Fundamentals of engineering creativity	The discipline is aimed at familiarizing students with the methods of engineering creativity, shaping their knowledge, skills and abilities to use the methods of searching for new technical solutions. The course will teach students how to formulate and solve inventive problems that arise in the process of design development, as well as in the technical development of new products, their operation and repair.	5	v		v	v						
Cycle of profile disciplines University component													
32	Power sources	The study of the material of this course allows you to get some knowledge of the device power sources, skills using these devices as a tool in their professional activities. Sources of primary power. Electromagnetic elements of power devices. Transformers. Smoothing filters. Switching power supplies. Control of the regulating element in the switching power supplies. AC-DC converters.	4	v									
33	Engineering thermodynamics and electrodynamics	The discipline is aimed at developing the student's theoretical and practical base for carrying out heat engineering calculations of heat and power equipment and assessing its thermodynamic efficiency. The course studies the basic laws and fundamental principles of technical thermodynamics, the properties and processes of changing the states of working bodies, the principles of energy conversion in heat and refrigeration machines, thermodynamic cycles.	5	v		v							
34	Embedded systems in robotics	The discipline aims to give students an idea of modern technologies for building embedded control systems, theoretical and practical aspects of the development of microcontroller systems and to promote the development of system thinking. The course covers the main issues of building embedded systems for controlling robots based on microcontrollers, focusing on a promising high-performance and energy-efficient family of microcontrollers.	6										
35	Programming for engineers with MATLAB	The discipline is aimed at studying typical mathematical schemes for modeling systems, familiarizing with the main approaches to simulating systems, studying modern methods of simulating physical control processes in devices, in technical means of automation and technological processes in the MATLAB environment.	4		v								
Cycle of profile disciplines Component of choice													
36	Measuring instrument accuracy	The discipline is aimed at preparing students for solving practical problems of assessing the accuracy of measuring instruments. As a result of studying the discipline, the student knows the definition of accuracy, the causes and types of errors in the functioning of devices, methods for assessing various types of errors and their influence on the resulting accuracy of the functioning of devices.	5								v	v	
37	Control and measuring Instrumentation	The discipline "Hydropneumoprivod" studies the following main issues: the principle of operation; classification; basic parameters of volumetric and paddle hydraulic	5	v		v							

		machines; examples of designs; features of working processes, designs and calculation methods of hydraulic machines; the principle of operation of volumetric and hydrodynamic gears. The knowledge gained by students while studying the materials of the theoretical and laboratory part of the discipline is used in the study of subsequent disciplines and final qualifying work.											
38	Sensor systems in robotics	The discipline is aimed at acquiring students' knowledge about sensors designed for robotic and mechatronic systems and complexes, such as load cells, flex sensors, infrared and optical sensors, and others. In this course, the student will learn how to program and receive, process data from these sensors.	5	v					v				
39	Touch electronics, sensors	The discipline is aimed at acquiring students' knowledge about the principles of operation, basic parameters, designs of sensors, measuring transducers based on them and sensors for various purposes. Studies the basics of physical phenomena and processes underlying the principles of sensors and measuring transducers.	5	v					v				
40	Robot drives	The discipline is aimed at studying the main and modern types of drives used in industrial and domestic robots, functional diagrams included in its composition, drives of robots and elements, static and dynamic characteristics; ways to improve the dynamics with the help of corrective feedbacks; microprocessor control devices for robot drives.	6					v	v				
41	Hydropneumatic drives of robots	The discipline "Hydropneumoprivod" studies the following main issues: the principle of operation; classification; basic parameters of volumetric and paddle hydraulic machines; examples of designs; features of working processes, designs and calculation methods of hydraulic machines; the principle of operation of volumetric and hydrodynamic gears. The knowledge gained by students while studying the materials of the theoretical and laboratory part of the discipline is used in the study of subsequent disciplines and final qualifying work.	6	v					v				
42	Simulation of dynamic systems	The discipline is aimed at studying the principles of building simulation modeling of dynamic systems on MATLAB / SIMULINK and analyzing the flow of dynamic processes in robot drives and evaluating the indicators of the positioning process, as well as simulation methods for building control systems for mechatronic and robotic systems.	5										
43	Modeling of measuring systems	The discipline is aimed at studying the model of information and signal transformation in measuring systems, studying the main characteristics of measuring instruments and methods for their calculation and forecasting; study of the principles of construction of measuring instruments and systems; mastering the technology of computer simulation in the study, design of measuring systems.	5			v			v				
44	Machine Learning Theory and Neural Networks	This discipline includes the study of the foundations of Machine learning and neural networks and their practical applications. There will be considered types of neural networks, methods and algorithms used in machine learning and neural networks.	5						v				
45	Fuzzy logic and neural networks	The discipline includes the study of the basics of fuzzy logic and neural networks and their practical application in modern technology. Methods and algorithms used in fuzzy logic and neural networks for solving problems of optimal control of robotic	5			v			v				

		and mechatronic systems and complexes under uncertainty will be considered.												
46	Electronic circuit design	The discipline is aimed at studying the principles of organization and methods of designing electronic circuits, including methods of computer-aided design, construction of mathematical models and software tools, i.e. what allows modern specialists to set and solve complex problems of designing devices and complexes of electronic equipment.	5						v					
47	Capstone research project 1	The course will allow students to learn how to transform an idea into a concrete solution and determine the most optimal approach to its implementation. The course participants will gain a holistic understanding of the process, key techniques and tools necessary for the design, development and further development of their products and services. As a result, students will get acquainted with the methods of rapid design of prototype solutions, learn how to plan the stages of work on the product and evaluate their labor intensity, will be able to find non-standard solutions to take into account the specific conditions of the tasks performed and develop innovative solutions.	5			v		v	v					
48	Robot design	The discipline covers the issues of robot design from the point of view of creating robotic systems and complexes, including mechanical and electronic systems. The discipline provides in-depth knowledge about the main stages of creating a robotic device and complexes.	5						v					
49	Capstone research project 2	The Capstone Research Project 2 course is a continuation of the Capstone Research Project 1 course. The course "Capstone research project 2" is an independently completed 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				

5. Curriculum of educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV

APPROVED

Chairman of the Management Board-
Rector of Kaznu named after K.Satpayev
_____ M.M. Begentaev
«____» _____ 2022 y.

CURRICULUM
of Educational Program on enrollment for 2022-2023 academic year
Educational program 6B07113 - "Robotics and mechatronics"
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 amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		IV course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
M-1. Module of language training															
LNG 108	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	Difcredit	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					
GEN 429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	Э		5						
M-4. Module of socio-cultural development															
HUM 100	Modern 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 120	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E			3					
HUM 134	Socio-political knowledge module (culturology, psychology)		5	150	2/0/1	150	E				5				
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM 133	Fundamentals of anti-corruption culture	GED, CCH	5	150	2/0/1	150	E				5				
MNG 488	Fundamentals of Entrepreneurship and Leadership														
CHE 656	Ecology and life safety														
M-6. Module of physical and mathematical training															
MAT 101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
MAT 102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
MAT 103	Математика III	BD, UC	5	150	1/0/2	105	Э			5					
M-7. Module of physical and chemical preparation															
PHY 111	Physics I	BD, UC	5	150	1/1/1	105	E	5							

CHE846	General chemistry	BD, UC	4	120	1/1/1	75	E	4							
PHY 112	Physics II	BD, UC	5	150	1/1/1	105	E		5						
M-8. Robotics Module															
2201	Elective	BD, EC	5	150		105	E			5					
2202	Elective	BD, EC	5	150		105	E				5				
M-9. Electronics and Circuit Engineering module															
ROB538	Fundamentals of Electromechanics and electronics	BD, UC	6	180	2/1/1	120	E			6					
ROB154	Electronics	BD, UC	5	150	1/1/1	105	E				5				
ROB573	Integrated and microprocessor circuitry	BD, UC	5	150	2/1/0	105	E					5			
M-10. Robot Mechanics Module															
ROB503	Robot mechanics	BD, UC	5	150	2/0/1	105	E				5				
ROB173	Mechanics of manipulators	BD, UC	5	150	2/0/1	105	E					5			
ROB534	Mechanics of controlled machines	BD, UC	5	150	2/0/1	105	E						5		
M-11. Robot Control System Module															
ROB515	Basics of automation	BD, UC	5	150	2/1/0	105	E					5			
3203	Elective	BD, EC	5	150		105	E					5			
3204	Elective	BD, EC	4	120	1/1/1	75	E						4		
3206	Elective	BD, EC	6	180	1/1/2	120	E							6	
M-12. Measurement and power supply module															
ROB187	Fundamentals of information and measurement technologies	BD, UC	5	150	2/1/0	105	E					5			
ROB574	Power sources	PD, UC	4	120	1/1/1	75	E						4		
4302	Elective	PD, EC	5	150		105	E							5	
M-13. Module of robotic systems															
ROB535	Engineering thermodynamics and electrodynamics	PD, UC	5	150	2/0/1	105	E						5		
ROB552	Embedded systems in robotics	PD, UC	6	180	1/1/2	120	E							6	
4301	Elective	PD, EC	5	150		105	E							5	
4303	Elective	PD, EC	6	180		120	E							6	
M-14.Modeling module															
ROB550	Programming for engineers with MATLAB	PD, UC	4	120	1/1/1	75	E						4		
4305	Elective	PD, EC	5	150		105	E								5
4306	Elective	PD, EC	5	150		105	E								5
M-15. R&D module															
ROB527	Fundamentals of research methodology	BD, UC	5	150	2/0/1	105	E					5			
3205	Elective	BD, EC	5	150		105	E						5		
4304	Elective	PD, EC	5	150		105	E							5	
4307	Elective	PD, EC	5	150		105	E								5
M-16. Practice-oriented module															
AAP179	Educational practice	BD, UC	2						2						
AAP174	Industrial practice I	PD, UC	2								2				
AAP193	Industrial practice II	PD, UC	3										3		
M-17. Module of final certification															
ECA003	Preparation and writing of a thesis (project)	FC	6												6
ECA103	Defense of the thesis (project)	FC	6												6
M-18. Module of additional types of training															
AAP500	Military affairs	ATT	0												
								31	29	31	29	30	30	33	27
	Total based on UNIVERSITY:							**60**		**60**		**60**		**60**	

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

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

SATBAYEV UNIVERSITY

APPROVED
Director of the Institute of Automation and Information Technology
_____R.K. Uskenbayeva
«___» _____ 2022 y.

ELECTIVE DISCIPLINES for 2022-2023 academic year entrolment
Educational program 6B07113 - Robotics and mechatronics
Group of educational programs B063 - Electrical engineering and automation

Full-time study Study duration : 4 years Academic degree: bachelor of engineering and technology

Year of study	Elective code according to the curriculum	Discipline code	Name of disciplines	Term	Cycle	Credits	Total hours	lek/lab/pr	SRS (including SRSP) in hours
	Robotics Module								
	2201	ROB185	Industrial Robotics	3	BD, EC	5	150	2/0/1	105
		ROB553	Service robotics					2/0/1	
	2202	ROB523	Phytomorphic and anthropomorphic robotics	4	BD, EC	5	150	2/0/1	105
		ROB511	Autonomous mobile robots					2/0/1	
	Robot Control System Module								
	3203	ROB546	Programming for microcontrollers	5	BD, EC	5	150	1/1/1	105
		ROB504	Programming in a high-level language					2/1/0	
	3204	ROB544	Microprocessor control devices of robots	6	BD, EC	4	120	1/1/1	75
		ROB545	Microcontroller control systems					1/1/1	
	3206	ROB570	Robot management	7	BD, EC	6	180	1/1/2	120
		ROB571	Control and dynamic systems					1/1/2	
	Measurement and power supply module								
	4302	CSE577	Measuring instrument accuracy	7	PD, EC	5	150	2/1/0	105
		ROB189	Control and measuring Instrumentation					2/1/0	
	Robotic systems module								
	4301	ROB139	Sensor systems in robotics	7	PD, EC	5	150	2/1/0	105
		ROB138	Touch electronics, sensors					2/1/0	
	4303	ROB548	Robot drives	7	PD, EC	6	180	1/1/2	120
		ROB549	Hydropneumatic drives of robots					1/1/2	
	Simulation module								
	4305	ROB551	Simulation of dynamic systems	8	PD, EC	5	150	1/1/1	105
		ROB168	Modeling of measuring systems					2/1/0	
	4306	ROB144	Machine Learning Theory and Neural Networks	8	PD, EC	5	150	2/1/0	105
		ROB126	Fuzzy logic and neural networks					2/1/0	
	R&D module								
	3205	ROB141	Statistical Methods in Engineering Research	6	BD, EC	5	150	2/0/1	105
		ROB153	Fundamentals of engineering creativity					2/0/1	
	4304	ROB109	Electronic circuit design	7	PD, EC	5	150	2/1/0	105
		ROB540	Capstone research project 1					0/0/3	
	4307	ROB166	Robot design	8	PD, EC	5	150	2/1/0	105
		ROB541	Capstone research project 2					0/0/3	

Number of credits in elective disciplines for the entire period of study	
Cycles of disciplines	**Credits**
Cycle of basic disciplines (BD)	30
Cycle of major disciplines (PD)	36
TOTAL:	**66**

Number of credits for the entire study period

Cycle code	Cycles od disciplines	Credits			
		Mandatory component (MK)	University component (UC)	Component of choice (CC)	Total
GED	Cycle of general education disciplines	51		5	56
BD	Cycle of basic disciplines		82	30	112
PD	Cycle of profile disciplines		24	36	60
	Total for theoretical training:	***51***	***106***	***71***	***228***
FA	Final attestation	12			12
	IN TOTAL:	**63**	**106**	**71**	**240**

Remark:
1. The names and amount of modules related to Module of basic training and professional activity are prescribed by departments themselves
2. * - Division into types of work is at the department's discretion
3. If necessary, the disciplines: Physics II, Mathematics III, General Chemistry of the department include, at the expense of credits, the department's component of BD, UC from the basic training module
4. The full academic load of one academic year should be 60 academic credits
5. The application of elective disciplines catalog in the same way as Curriculum is divided into modules, with the inclusion of "R&D" module

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № __от "____" _____20___ y.
Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № __от "____" _____20___ y.
Decision of the Academic Council of the Institute of A&IT. Protocol № __от "____" _____20___ y.

Vice-Rector for Academic Affairs _____ **B.A. Zhautikov**
Director of the Institute of Automation and Information Technology _____ **R.K. Uskenbayeva**
Head of the Department of Robotics and Automation Equipment _____ **K.A. Ozhikenov**
Specialty Council representative from employers _____ **A.K. Dzhumagulov**

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 mastering the additional educational programs (Minor)
Integrated and microprocessor circuitry	5	5	an additional specialty Minor is assigned with the issuance of an Appendix to the diploma of the established sample
Fundamentals of information and measuring technologies	5	5	
Theory of mechanisms and machines	5	5	
Fundamentals of automation	5	5	