



**Institute of Automation and Information Technology  
Department “Robotics and Engineering Tools of Automation”**

**EDUCATIONAL PROGRAM  
7M07107 Robotics and Mechatronics**

Code and classification of the field of education:

**7M07** Engineering, manufacturing and construction industries

Code and classification of training directions:

**7M071 Engineering and engineering trades**

Group of educational programs:

**M102 Robotics and mechatronics**

Level based on NQF: **7**

Level based on IQF: **7**

Study period: **2 year**

Amount of credits: **120**

**Almaty 2024**

Educational program 7M07107 Robotics and Mechatronics was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes #3 dated 27.10.2022

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

Minutes #2 dated 21.10.2022

Educational program 7M07107 Robotics and Mechatronics was developed by Academic committee based on direction 7M071 Engineering and engineering trades

| Full name                                  | Academic degree/<br>academic title                       | Position                                | Workplace                                                                                    | Signature                                                                             |
|--------------------------------------------|----------------------------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>Chairperson of Academic Committee:</b>  |                                                          |                                         |                                                                                              |                                                                                       |
| Baktybaev<br>Murat<br>Kyrgyzbaevich        | Candidate of<br>Physical and<br>Mathematical<br>Sciences | Associate<br>Professor                  | Department of «Robotics<br>and Engineering Tools of<br>Automation», K.I.<br>Satbayev KazNRTU |   |
| <b>Teaching staff:</b>                     |                                                          |                                         |                                                                                              |                                                                                       |
| Ozhikenov<br>Kassymbek<br>Adilbekovich     | Candidate of<br>Technical Sciences                       | Professor,<br>Head of the<br>Department | Department of «Robotics<br>and Engineering Tools of<br>Automation», K.I.<br>Satbayev KazNRTU |  |
| <b>Employers:</b>                          |                                                          |                                         |                                                                                              |                                                                                       |
| Dzhumagulov<br>Arystanbek<br>Kuyzymbaevich | -                                                        | General<br>Director                     | LLP «MEDREMZAVOD<br>HOLDING»                                                                 |  |
| Akzhanov Janat<br>Koishibaevich            | -                                                        | Director                                | LLP «SAIMA<br>Corporation»                                                                   |                                                                                       |
| <b>Students</b>                            |                                                          |                                         |                                                                                              |                                                                                       |
| Shylmyrza<br>Usen Jumanuly                 | -                                                        | 1st<br>Master's<br>student              | Department of «Robotics<br>and Engineering Tools of<br>Automation», K.I.<br>Satbayev KazNRTU |  |

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### **List of abbreviations and designations**

EP - Educational program

BD - basic disciplines

PD - profile disciplines

ECTS - European Credit Transfer and Accumulation System

USEC - Universal, social and ethical competencies

S&MC - Special and managerial competencies

PC - Professional competence

EO - educational outcomes

FA - Final attestation

## 1. Description of educational program

Master's degree in the field of training "Robotics and mechatronics" should be prepared to solve professional tasks in accordance with the profile of the master's program and the types of professional activities:

*research activities:*

- analysis of scientific and technical information, domestic and foreign experience in the development and research of robotic and mechatronic systems; study of new methods of control theory, artificial intelligence technologies and other scientific areas that make up the theoretical base of robotics and mechatronics, preparation and publication of reviews and abstracts;
- conducting theoretical and experimental research in the field of developing new samples and improving existing robotic and mechatronic systems, their modules and subsystems, searching for new ways of managing and processing information using artificial intelligence, fuzzy logic, multi-agent control methods, artificial neural and neuro-fuzzy networks;
- conducting patent research supporting the development of new robotic and mechatronic systems in order to protect intellectual property objects, research and development results obtained;
- conducting the development of experimental samples of robotic and mechatronic systems, their modules and subsystems in order to verify and substantiate the main theoretical and technical solutions to be included in the terms of reference for the performance of development work;
- organizing and conducting experiments on existing robotic and mechatronic systems, their subsystems and individual modules in order to determine their effectiveness and determine ways to improve, processing the results of experimental studies using modern information technologies;
- preparation of reports, scientific publications and reports at scientific conferences and seminars, participation in the implementation of research and development results in practice;

*design and development activities:*

- preparation of a feasibility study of projects for new robotic and mechatronic systems, their individual subsystems and modules;
- calculation and research of robotic and mechatronic systems, control, information-sensory and Executive subsystems using mathematical modeling methods, layout and testing of existing systems, processing of experimental data with the use of modern information technologies;
- development of special software for solving problems of designing robotic and mechatronic systems, development of technical specifications and direct participation in the design of mechanical, mechatronic and robotic modules, design of mechatronic and robotic devices, control and information processing systems;

*organizational and managerial activities:*

- development of organizational and technical documentation (work schedules, instructions, plans, estimates) and established reporting in accordance with approved forms;

- organization of work of small groups of performers involved in research, design and experimental research;

- monitoring the implementation of measures to prevent industrial injuries, occupational diseases, and prevent environmental violations during the research and operation of robotic and mechatronic systems;

*installation and commissioning activities:*

- participation in verification, adjustment, adjustment, equipment condition assessment and configuration of robotic and mechatronic systems for various purposes, including both technical means and software control systems;

- participation in the interfacing of software and hardware complexes with technical objects as part of robotic and mechatronic systems, in conducting tests and commissioning prototypes of such systems;

*service and maintenance activities:*

- participation in the verification, adjustment, adjustment and evaluation of the state of robotic and mechatronic systems for various purposes, as well as their individual subsystems, in the setting up of control hardware and software complexes;

- preventive maintenance of technical condition and functional diagnostics of robotic and mechatronic systems for various purposes, as well as their individual subsystems;

- preparation of operating instructions for robotic and mechatronic systems and their hardware and software, development of routine testing programs;

- preparation of applications for equipment and components, preparation of technical documentation for equipment repair;

*scientific and pedagogical activity:*

- participation in the development of programs of academic disciplines and courses based on the study of pedagogical, scientific, technical and scientific-methodical literature, as well as the results of their own professional activities;

- participation in setting up and modernizing individual laboratory works and workshops in professional disciplines;

- conducting training sessions with students, participating in the organization and management of their practical and research work;

- application and development of new educational technologies, including computer and distance learning systems.

The term of study in the master's program is determined by the volume of academic credits mastered. When the established amount of academic credits is mastered and the expected learning outcomes for obtaining a master's degree are achieved, the master's degree program is considered fully mastered. In the scientific and pedagogical master's program, at least 120 academic credits are awarded for the entire period of study, including all types of educational and scientific activities of the master's student.

Planning of the content of education, the way of organizing and conducting the educational process is carried out by the University and scientific organization independently on the basis of credit technology of training.

The master's program in scientific and pedagogical direction implements educational programs of postgraduate education for the training of scientific and

scientific and pedagogical personnel for Universities and scientific organizations with in-depth scientific and pedagogical and research training.

The content of the master's degree EP consists of:

- 1) theoretical training, including the study of cycles of basic and profile disciplines;
- 2) practical training of undergraduates: various types of internships, scientific or professional internships;
- 3) research work, including the execution of a master's thesis – - for the scientific and pedagogical master's program
- 4) final certification.

Final certification is carried out in the form of writing and defending a master's thesis.

## 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:** - development of students through research activities, critical thinking, development of professionally oriented skills and abilities;

- using highly professional training of undergraduates in various educational environments;

- training a new competitive generation of technical specialists for the labor market;

- developing an environment that supports people of different cultures, and creating an atmosphere of striving for knowledge, academic integration and intellectual motivation;

- conducting research and educational activities based on the world's best practices, developing their own methods and style of training specialists;

- development of cooperation "University-industry" to meet the requirements of the labor market for technical specialists, to improve the quality of educational programs for training specialists;

- development of additional educational and training programs using multimedia, new teaching technologies for organizing learning based on the principle of lifelong learning;

- establishing partnerships with other universities and organizations to improve the quality of education, to support technical and cultural ties.

### Competencies for completing training

| Universal, social and ethical competencies (USEC) |                                                                                                                                                                                                                                                                   |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| U-1                                               | Ability to communicate orally and in writing in the state, Russian and foreign languages to solve problems of interpersonal and intercultural interaction                                                                                                         |
| U-2                                               | The ability to assess the surrounding reality based on worldview positions formed by knowledge of the basics of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical knowledge |
| U-3                                               | Develop an environment that welcomes and supports people from different cultures, and create an atmosphere of striving for knowledge, academic integration, and intellectual motivation                                                                           |
| U-4                                               | Have the skills of social design and methods of forming and maintaining the socio-psychological climate in the organization                                                                                                                                       |
| U-5                                               | Ability to critically use the methods of modern science in practice                                                                                                                                                                                               |
| U-6                                               | Awareness of the need and ability to learn and improve their skills independently throughout their working life                                                                                                                                                   |
| Special and managerial competencies (S&MC)        |                                                                                                                                                                                                                                                                   |

|                                       |                                                                                                                                                                                                                                       |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S-1                                   | Independently manage and control the processes of work and training activities within the framework of the strategy, policy and goals of the organization, discuss problems, argue conclusions and correctly operate with information |
| S-2                                   | Organize the activities of the production team, make organizational and managerial decisions in the context of different opinions and evaluate the consequences of decisions                                                          |
| S-3                                   | Organize work in the division to improve, modernize, and unify the manufactured robotic and mechatronic systems                                                                                                                       |
| S-4                                   | Readiness to lead and participate in the preparation of a feasibility study of projects for the creation of robotic and mechatronic systems, their subsystems and individual modules                                                  |
| S-5                                   | Ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities                                                                                                                  |
| <b>Professional competencies (PC)</b> |                                                                                                                                                                                                                                       |
| PC-1                                  | The ability to analyze literature data and, based on the analysis, be able to determine and experimentally implement possible ways to improve the quality of robotic systems                                                          |
| PC-2                                  | Ability to conduct professional written and oral communication with all stakeholders in the field of robotics and mechatronics                                                                                                        |
| PC-3                                  | The ability to demonstrate a sustained interest in self-study and training of both wards and colleagues, to guide and advise them throughout the entire period of professional activity                                               |
| PC-4                                  | Ability to demonstrate a high level of professional activity while solving industrial and / or scientific tasks, observing all the principles of legal and ethical standards                                                          |
| PC-5                                  | Ability to conduct independent research in the field of robotics and mechatronics and modernize existing robotic and mechatronic systems, introduce new methods of digital signal processing with elements of artificial intelligence |
| PC-6                                  | Ability to design modern and reliable blocks and devices, intelligently controlled Executive, information-sensor and navigation modules of robotic and mechatronic systems                                                            |
| PC-7                                  | Ability to apply modern software products and the latest technologies to solve and manage interdisciplinary engineering problems in various fields of science and technology                                                          |
| PC-8                                  | Ability to create adaptive and robust control systems for multi-agent robotic systems and special-purpose object systems in an unknown environment, taking into account their dynamic characteristics                                 |
| PC-9                                  | Ability to implement scientific results in the production of robotic and mechatronic systems, their subsystems and individual modules                                                                                                 |

### **3. Requirements for evaluating the educational program learning outcomes**

**EO1** - Organize and carry out work on the operation, installation and commissioning of robotic and mechatronic systems and complexes, including both technical means and software control complexes.

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

**EO3** – Demonstrate a high level of professional activity while solving production and/or scientific tasks, observing all the principles of legal and ethical standards.

**EO4** – Design modern and reliable blocks and devices, intelligently controlled executive and information-sensor and navigation modules of robotic and mechatronic systems and complexes.

**EO5** – Demonstrate a steady interest in self-study and training of both wards and colleagues, guide and advise them throughout the entire period of professional activity.

**EO6** – To conduct research in the field of developing new samples and improving existing mechatronic and robotic systems, to look for new ways of processing information with elements of artificial intelligence.

**EO7** – To study special literature and other scientific and technical information on the achievements of domestic and foreign science, technology and technologies in the field of robotics and mechatronics.

## 4. Passport of educational program

### 4.1. General information

| №  | Field name                                        | Comments                                                                                                                                                                                                                                                                                                                                                                 |
|----|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Code and classification of the field of education | 7M07 Manufacturing and processing industries                                                                                                                                                                                                                                                                                                                             |
| 2  | Code and classification of training directions    | 7M071 Engineering and engineering trades                                                                                                                                                                                                                                                                                                                                 |
| 3  | Educational program group                         | M102 Robotics and mechatronics                                                                                                                                                                                                                                                                                                                                           |
| 4  | Educational program name                          | 7M07107 Robotics and Mechatronics                                                                                                                                                                                                                                                                                                                                        |
| 5  | Short description of educational program          | Training of highly qualified specialists in the field of development of new control methods, information processing and search for new design solutions for mechatronic and robotic systems of general purpose, their subsystems and individual modules, conducting research in the field of mechatronics, robotics, control theory and artificial intelligence methods. |
| 6  | Purpose of EP                                     | The purpose of the educational program is to provide high-quality training of highly qualified specialists in the field of robotics and mechatronics, ready to solve scientific, pedagogical and production tasks of professional activity in modern conditions                                                                                                          |
| 7  | Type of EP                                        | New                                                                                                                                                                                                                                                                                                                                                                      |
| 8  | The level based on NQF                            | 7                                                                                                                                                                                                                                                                                                                                                                        |
| 9  | The level based on IQF                            | 7                                                                                                                                                                                                                                                                                                                                                                        |
| 10 | Distinctive features of EP                        | -                                                                                                                                                                                                                                                                                                                                                                        |
| 11 | List of competencies of educational program       | In the field of research methodology; in the field of scientific and scientific-pedagogical activity in higher educational institutions; in matters of modern educational technologies; in the implementation of scientific projects and research in the professional field; in the field of information analysis.                                                       |
| 12 | Learning outcomes of educational program          | EO1-EO07                                                                                                                                                                                                                                                                                                                                                                 |
| 13 | Education form                                    | full-time                                                                                                                                                                                                                                                                                                                                                                |
| 14 | Period of training                                | 2 year                                                                                                                                                                                                                                                                                                                                                                   |
| 15 | Amount of credits                                 | 120                                                                                                                                                                                                                                                                                                                                                                      |
| 16 | Languages of instruction                          | russian, kazakh                                                                                                                                                                                                                                                                                                                                                          |
| 17 | Academic degree awarded                           | Master of Technical Sciences/Master of Engineering and Technology in the educational program «7M07107 Robotics and Mechatronics»                                                                                                                                                                                                                                         |
| 18 | Developer(s) and authors                          | Ozhikenov K.A.,<br>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 |
| Cycle of basic disciplines<br>University component |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                                     |     |     |     |     |     |     |
| 1.                                                 | Foreign language (professional)   | The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies. public discussions; interpret and present the results of scientific research in a foreign language.                                                                                                                                                                                                          | 5                 |                                     |     | v   |     |     |     |     |
| 2.                                                 | Psychology of management          | The discipline studies the modern role and content of psychological aspects in managerial activity. The improvement of the psychological literacy of the student in the process of implementing professional activities is considered. Self-improvement in the field of psychology and studying the composition and structure of management activities, both at the local level and abroad. The psychological feature of modern managers is considered.                                                                                                                                                                                                     | 3                 |                                     |     |     |     | v   |     |     |
| 3.                                                 | History and philosophy of science | The subject of philosophy of science, dynamics of science, specifics of science, science and pre-science, antiquity and the formation of theoretical science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.                                                                                                                                                                     | 3                 |                                     |     | v   |     |     |     |     |
| 4.                                                 | Higher school pedagogy            | Undergraduates will master the methodological and theoretical foundations of higher school pedagogy, plan and organize the processes of teaching and upbringing, master the communicative technologies of subject-subject interaction between a teacher and a master in the educational process of a university.                                                                                                                                                                                                                                                                                                                                            | 3                 |                                     | v   |     |     |     |     |     |
| 5.                                                 | Pedagogical practice              | Knowledge of the history of the development of general psychological ideas modern methods of systematic organization of cognitive processes theories and problems. General psychology theoretical and applied analysis and comparison of research results and knowledge of technical disciplines; application of methods and techniques; independent use in the context of scientific research development and application of ideas; processes and analysis of existing phenomena critical thinking of concepts, theories and approaches analysis from a perspective. Research activities mastering the skills of standard scientific tasks educational and |                   |                                     |     |     |     |     |     |     |

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|                                   |                                                                         | pedagogical credit training methods of teaching professional disciplines.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |  |   |  |  |   |  |   |
| <b>Cycle of basic disciplines</b> |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |  |   |  |  |   |  |   |
| <b>Component of choice</b>        |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |  |   |  |  |   |  |   |
| 6.                                | Dynamics of robotic systems                                             | The purpose of the discipline is to study the issues of modeling the dynamics of robotic systems. To understand the dynamics of robots and basic concepts and definitions, fundamental principles and the most common and effective modeling methods Contents: concepts of a dynamic model and equations of motion. Problems of dynamics Fundamental principles of mechanics. The movement of the point mass. The movement of an absolutely rigid body. Assignment forms and methods for deriving equations of motion. Equations of motion in configuration space.                     | 5 |  |   |  |  | v |  |   |
| 7.                                | Intelligent control and information processing systems                  | The discipline is aimed at studying the theoretical foundations and practical mastering of working with neural networks, genetic algorithms and expert systems. Formation of practical skills in the use of intelligent systems for management. Understanding the place of intelligent methods among all information technologies. The concept of basic intelligent technologies, their use in computer control systems and application for solving applied problems                                                                                                                   | 5 |  |   |  |  | v |  |   |
| 8.                                | Intellectual property and scientific research                           | Purpose: the goal is to train specialists who can effectively manage rights to the results of intellectual activity in the field of science, as well as ensure their legal protection and commercialization. Contents: analysis of legal protection of research and development results, methods of commercialization of scientific inventions, ethical and legal aspects of scientific activity in the context of IP.                                                                                                                                                                 | 5 |  |   |  |  | v |  |   |
| 9.                                | Methods for solving inventive tasks                                     | Purpose: the development of the discipline is the development of skills to use tools and methods for solving inventive tasks in the search for solutions to practical and professional problems. Content: introduction to the phenomenon of inventive problem solving and its modern architectonics. Characterization of the levels of creative tasks and the development of key concepts. The concept of the functional nature of problem situations (how they are "split" into inventive and non-inventive tasks). Description of a technical object based on a systematic approach. | 5 |  |   |  |  |   |  | v |
| 10                                | Application of methods of technical creativity in innovative activities | The purpose of studying the discipline is to master the basics of practical application of methods of technical creativity in innovation. The basic knowledge and skills of applying the methods of technical creativity in innovation are offered. After studying the course, a master's student must demonstrate the ability to analyze, synthesize and design methods of technical creativity in innovation.                                                                                                                                                                        | 5 |  |   |  |  |   |  | v |
| 11                                | Mathematical modeling and optimization of                               | The purpose of studying the discipline is to study the principles of modeling the movement of multi-link systems, which are the majority of                                                                                                                                                                                                                                                                                                                                                                                                                                            | 5 |  | v |  |  |   |  |   |

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|                                     | motion of multi-tier systems                       | mechatronic systems that are multi-link, such as manipulators of industrial robots, etc., at the design stage. The study of the main elements of the SimMechanics library and the principles of forming models of spatial mechanisms and machines in the SimMechanics environment, visualization of the movements of spatial mechanisms and machines using the built-in SimMechanics tools.                                                                                                                                                                                      |   |  |   |  |  |   |   |
| 12                                  | Biotechnical control systems                       | The objectives of the development of the discipline: the formation of knowledge, skills, abilities and competences on the management systems of biotechnical systems; forming a belief about the need for the development of automatic biotechnical systems for human life support; use of information tools necessary for future professional activities                                                                                                                                                                                                                        | 5 |  |   |  |  |   | v |
| 13                                  | Sustainable development strategies                 | The goal is to develop deep knowledge and competencies in the development and implementation of sustainable development strategies at various levels. The content covers a wide range of topics, ranging from global environmental challenges such as climate change, biodiversity loss and natural resource depletion, to socio-economic aspects including inequality, health and education.                                                                                                                                                                                    | 5 |  |   |  |  | v |   |
| <b>Cycle of profile disciplines</b> |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |  |   |  |  |   |   |
| <b>University component</b>         |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |  |   |  |  |   |   |
| 14                                  | Intelligent control technology                     | The purpose of the discipline is to study the theoretical foundations of artificial intelligence, neural network technologies of intelligent systems, technologies for building control systems with fuzzy logic, rules of fuzzy logic, technologies for creating a knowledge base, expert control systems, adaptive control systems, problems of theory and technology of intelligent systems, etc. This knowledge is necessary for further understanding of the principles of building robotic systems.                                                                        | 5 |  | v |  |  |   |   |
| 15                                  | Research practice                                  | Necessary for the successful implementation of research activities formation of professional skills and abilities, research master's degree programs; direct in order to master the professional qualities of a specialist practical activities; Organization of interaction and communication of undergraduates to adapt to their future profession specialists, undergraduates for future professional activities development of a creative and research approach, their mastering the skills of analyzing labor results, self-discipline formation of the need for education. |   |  |   |  |  |   |   |
| <b>Cycle of profile disciplines</b> |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |  |   |  |  |   |   |
| <b>Component of choice</b>          |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |  |   |  |  |   |   |
| 16                                  | Control of mobile robots in an unknown environment | The purpose of teaching the discipline is to form masters' knowledge about automatic and automated control of mobile robots, methods and methods of designing, debugging and operating mobile robots using computer-aided design and production systems, taking into account unknown, random, non-deterministic influences. The issues of mathematical                                                                                                                                                                                                                           | 5 |  |   |  |  |   | v |

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|    |                                                      | description of static and dynamic objects, development and design of mechanical and electrical components of robotic and mechatronic systems with their subsequent automated control are considered.                                                                                                                                                                                                                                                                                                                                                                                      |   |  |  |  |   |   |   |  |
| 17 | Intellectual management in conditions of uncertainty | The discipline "Intellectual management in conditions of uncertainty" is aimed at studying the problems of managing continuous dynamic objects under uncertainty. The tools of sensitivity theory, interval model representations, generalized modal control, Lyapunov function method and adaptive control are studied. Designing control laws that deliver robustness to systems in the sense of the main indicators of the quality of their functioning. Non-adaptive and adaptive management methods.                                                                                 | 5 |  |  |  | v |   |   |  |
| 18 | Robot Navigation Systems                             | The purpose of the discipline is to study the types, purpose, general principles of operation of robot navigation systems, as well as the mathematical apparatus of modern navigation. To teach to understand the purpose of robot navigation systems and to apply modern robot navigation systems and tools. Inertial orientation and navigation system (IONS) for manipulative and mobile robots. Structure and purpose and sleep. Orientation and navigation algorithms for determining the kinematic parameters of a moving object using IONS.                                        | 5 |  |  |  |   |   | v |  |
| 19 | Technical means of information-measuring systems     | The purpose of studying the discipline is the formation of students' knowledge in the field of information and measurement systems: components, algorithms, structures, characteristics, varieties and purposes of modern information and measurement systems and their parts; features of the use of computers and computer technology in information and measurement systems; organization of human interaction and technology in information and measurement systems; metrological providing systems; sources, types and performance indicators of information and measurement systems | 5 |  |  |  | v |   |   |  |
| 20 | Project management                                   | The discipline studies the components of project management based on modern behavioral models of project-oriented business development management. The program is based on the international standards PMI PMBOK, IPMA ICB and the standards of the Republic of Kazakhstan in the field of project management. The features of organizational management of business development through the interaction of strategic, project and operational management are studied.                                                                                                                    | 5 |  |  |  | v |   |   |  |
| 21 | Multi-agent robotic systems                          | The purpose of studying the discipline is the study of multi-agent systems, which are one of the new promising areas of artificial intelligence, which was formed on the basis of research results in the field of distributed computer systems, network technologies for solving problems in parallel computing, in which the principle of autonomy of individual parts of the program, jointly functioning in a                                                                                                                                                                         | 5 |  |  |  |   | v |   |  |

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|----|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|--|--|---|---|--|
|    |                                                                  | distributed system, where many interconnected computing processes are simultaneously taking place programs called multiagents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |   |  |  |  |   |   |  |
| 22 | Reliability of technical systems                                 | The purpose of teaching the discipline is to study a wide range of issues: basic concepts and definitions of the theory of reliability of technical systems. Quantitative and qualitative characteristics of reliability. Mathematical models of reliability of devices and systems. Methods and main stages of determining the reliability indicators of the designed devices and systems. Improving reliability by redundancy. Calculation of reliability of devices and systems with information redundancy and temporary redundancy                                                                      | 5 |   |  |  |  | v |   |  |
| 23 | Diagnosis and reliability of technical systems and devices       | The purpose of studying the discipline is to study methods for assessing the reliability of technical systems at the design stage, to study methods for assessing the reliability of technical systems in operation, to apply probability theory to predict and prevent equipment failures, to study methods for diagnosing existing equipment. Accordingly, the teaching of the discipline "Diagnostics and reliability of technical systems and devices" is aimed at arming future specialists with knowledge of the basic provisions of the theory of reliability and survivability of technical systems. | 5 | v |  |  |  |   |   |  |
| 24 | Evaluation of reliability and survivability of technical systems | The discipline is aimed at studying methods for assessing the reliability of technical systems at the design stage, studying methods for assessing the reliability of technical systems in operation, applying probability theory to predict and prevent equipment failures. The basic concepts of reliability theory, such as the quality and reliability of the object, the causes and types of failures. Methods for assessing the reliability of recoverable systems without limitation and with a limited recovery time                                                                                 | 5 | v |  |  |  |   |   |  |
| 25 | Digital processing of measurement information                    | The purpose of the discipline is to study the role and significance of digital signal processing in the reception and transmission of information, the features and advantages of digital representation of signals, the study of digital transformation algorithms, the implementation of digital processing in telecommunications, information-measuring and radiophysical systems and its application in various fields of science, technology and production.                                                                                                                                            | 5 |   |  |  |  |   | v |  |
| 26 | Neuro fuzzy and hybrid control                                   | The purpose of studying the discipline is to familiarize with the principles and methods of building systems of neural fuzzy and hybrid control of a technical object based on the methods of the theory of artificial intelligence and modern software and hardware. Study of the structure, characteristics and functionality of the NeuralNetworksToolbox module of the MatLab software package for modeling neural networks; study of the structure, characteristics and functionality of the FuzzyLogicToolbox module of the MatLab software package for modeling fuzzy and hybrid control systems      | 5 |   |  |  |  |   | v |  |
| 27 | Designing special                                                | The purpose of teaching the discipline is to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 5 |   |  |  |  | v |   |  |

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY  
named after K.I.SATBAYEV»

|    |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |   |  |   |   |  |
|----|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|--|---|---|--|
|    | purpose robotic systems                                          | systematize and integrate previously acquired knowledge in the disciplines of bachelor's and master's training in the field of study. Definition and formalization of tasks facing robotics; drawing up requirements for components of robotic systems; the concept of problems of designing highly efficient mechatronic modules and systems of special-purpose objects; obtaining methodological foundations of system design of multicomponent integrated systems, taking into account the specifics of automated production.                                                                                                                                                          |   |   |   |  |   |   |  |
| 28 | Designing microprocessor and microcontroller systems             | The discipline is aimed at forming students' knowledge of the general methodology and specific design methods of the main varieties of modern microprocessor tools, as well as knowledge and skills in the field of architecture, principles of functioning and programming of microprocessor systems. Studies the architecture and functionality of modern microprocessors and microcontrollers; methods and technical means of debugging, diagnostics, modeling and design of microprocessor systems and microcontrollers                                                                                                                                                               | 5 |   |   |  | v |   |  |
| 29 | Organization and planning of production of mechatronic equipment | The purpose of studying the discipline is to study the methods of planning and production of medical equipment and the principles of the organization of the production process in the production of medical equipment. Scientific foundations of the organization of the production of medical equipment. Organization of auxiliary workshops and service farms of the enterprise for the production of medical equipment. Organization of research, design and technological preparation of medical equipment production. Organization and planning of management of the enterprise for the production of medical equipment. Organization of mastering the production of new equipment. | 5 | v |   |  |   |   |  |
| 30 | Information topologies and networks                              | The purpose of studying the discipline is to provide undergraduates with systematized knowledge about information topologies and networks in computer control systems of robotic systems. Formation of in-depth knowledge in the field of modern information and communication technologies, information culture. Mastering the skills of designing and practical implementation of various automated control systems for robotic systems.                                                                                                                                                                                                                                                | 5 |   |   |  | v |   |  |
| 31 | Deep learning for robots                                         | The purpose of studying the discipline is to develop undergraduates' skills in solving applied problems using deep neural networks. The course is dedicated to the methods of "deep learning" - a new generation of neural network methods of machine learning, which caused rapid development in a number of applied areas. Over the past few years, deep learning methods have become firmly entrenched in the applied fields of computer vision: visual image recognition, segmentation, color restoration using images, image description with tags, text processing, speech processing.                                                                                              | 5 |   | v |  |   |   |  |
| 32 | Robust systems                                                   | The purpose of studying the discipline is to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 5 |   |   |  |   | v |  |

|    |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |  |  |  |  |  |   |
|----|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--|--|--|--|--|---|
|    | and adaptive control            | familiarize undergraduates with the technical characteristics of adaptive, robust and robust-suboptimal control systems for single-connected, multi-connected and network linear and nonlinear objects. To study mathematical methods used in the synthesis of adaptive and robust control systems for dynamic objects. To teach how to use the studied methods to solve specific adaptation problems in stochastic dynamical systems                                                                                                                                                                                                                      |   |  |  |  |  |  |   |
| 33 | Planning an experiment          | Purpose: to prepare future specialists for research and organizational and managerial activities and processing of their results. Contents: general questions of the theory of experiment planning. An experiment as an object of research. Methods of the theory of experiment planning. The logical foundations. Statistical processing of measurement results. Analysis of measurement results. Fundamentals of experiment planning. A complete and fractional factorial experiment. Verification of the adequacy of the model obtained from experimental data. Computer methods of statistical processing of the results of an engineering experiment. | 4 |  |  |  |  |  | v |
| 34 | Statistical methods in research | Purpose: formation of logical and algorithmic thinking of students, which allows them to apply statistical methods in research. Content: 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 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.                                                                                                                                                          | 4 |  |  |  |  |  | v |

of Educational Program on enrollment for 2024-2025 academic year  
Educational program 7M07107 - Robotics and mechatronics  
Group of educational programs M102 - "Robotics and mechatronics"

| Form of study: full-time                                                  |                                                                              | Duration of study: 2 year |                         |             |                             | Academic degree: Master of Technical Sciences |                 |                            |            |            |            |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------|-------------------------|-------------|-----------------------------|-----------------------------------------------|-----------------|----------------------------|------------|------------|------------|
| 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 |            |            |            |
|                                                                           |                                                                              |                           |                         |             |                             |                                               |                 | 1 course                   |            | 2 course   |            |
|                                                                           |                                                                              |                           |                         |             |                             |                                               |                 | 1 semester                 | 2 semester | 3 semester | 4 semester |
| M-1. Module of basic training (university component)                      |                                                                              |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| LNG213                                                                    | Foreign language (professional)                                              | BD UC                     | 3                       | 90          | 0/0/2                       | 60                                            | E               | 3                          |            |            |            |
| HUM214                                                                    | Management Psychology                                                        | BD UC                     | 3                       | 90          | 1/0/1                       | 60                                            | E               | 3                          |            |            |            |
| HUM212                                                                    | History and philosophy of science                                            | BD UC                     | 3                       | 90          | 1/0/1                       | 60                                            | E               |                            | 3          |            |            |
| HUM213                                                                    | Higher school pedagogy                                                       | BD UC                     | 3                       | 90          | 1/0/1                       | 60                                            | E               |                            | 3          |            |            |
| component of choice                                                       |                                                                              |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB701                                                                    | Dynamics of robotic systems                                                  | BD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB204                                                                    | Intelligent information management and processing systems                    |                           |                         |             | 2/1/0                       |                                               |                 |                            |            |            |            |
| MNG781                                                                    | Intellectual property and scientific research                                |                           |                         |             | 2/0/1                       |                                               |                 |                            |            |            |            |
| ROB292                                                                    | Methods for solving inventive tasks                                          | BD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB262                                                                    | Application of methods of technical creativity in innovation                 |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB275                                                                    | Mathematical modeling and optimization of the movement of multi-link systems | BD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB257                                                                    | Biotechnical control systems                                                 |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| MNG782                                                                    | Sustainable development strategies                                           |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| M-2. Module of theoretical foundations of management (optional component) |                                                                              |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB284                                                                    | Intelligent control technology                                               | PD UC                     | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB555                                                                    | Managing mobile robots in an unknown environment                             | PD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB203                                                                    | Intelligent management in conditions of uncertainty                          |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB283                                                                    | Robot navigation systems                                                     | PD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            | 5          |            |
| ROB224                                                                    | Technical means of information and measuring systems                         |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| MNG705                                                                    | Project management                                                           |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| M-3. Control system design module (optional component)                    |                                                                              |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB265                                                                    | Multi-agent robotic systems                                                  | PD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB231                                                                    | Reliability of technical systems                                             |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB277                                                                    | Diagnostics and reliability of technical systems and devices                 | PD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB216                                                                    | Assessment of reliability and survivability of technical systems             |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB279                                                                    | Digital processing of measurement information                                | PD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               | 5                          |            |            |            |
| ROB285                                                                    | Neuro fuzzy and hybrid control                                               |                           |                         |             |                             |                                               |                 |                            |            |            |            |
| ROB281                                                                    | Design of special purpose robotic systems                                    | PD CCH                    | 5                       | 150         | 2/0/1                       | 105                                           | Э               |                            |            | 5          |            |
| ROB239                                                                    | Design of microprocessor and microcontroller systems                         |                           |                         |             | 2/1/0                       |                                               |                 |                            |            |            |            |

|                                          |                                                                                               |         |    |     |       |     |                |    |    |    |    |
|------------------------------------------|-----------------------------------------------------------------------------------------------|---------|----|-----|-------|-----|----------------|----|----|----|----|
| ROB280                                   | Organization and planning of mechatronic equipment production                                 | PD CCH  | 5  | 150 | 2/0/1 | 105 | 9              |    |    | 5  |    |
| ROB288                                   | Information topologies and networks                                                           |         |    |     |       |     |                |    |    |    |    |
| ROB274                                   | Deep learning of robots                                                                       |         |    |     |       |     |                |    |    |    |    |
| ROB286                                   | Robust systems and adaptive control                                                           | PD CCH  | 5  | 150 | 2/0/1 | 105 | 9              |    |    | 5  |    |
| ROB710                                   | Planning an experiment                                                                        |         |    |     |       |     |                |    |    |    |    |
| ROB711                                   | Statistical methods in research                                                               | PD CCH  | 4  | 120 | 0/0/3 | 75  | course project |    |    |    | 4  |
| <b>M-4. Practice-oriented module.</b>    |                                                                                               |         |    |     |       |     |                |    |    |    |    |
| AAP273                                   | Pedagogical practice                                                                          | BD UC   | 8  |     |       |     |                |    |    | 8  |    |
| AAP256                                   | Research practice                                                                             | PD CCH  | 4  |     |       |     |                |    |    |    | 4  |
| <b>M-5. Experimental research module</b> |                                                                                               |         |    |     |       |     |                |    |    |    |    |
| AAP268                                   | Research work of a master's student, including internship and completion of a master's thesis | RWMS UC | 4  |     |       |     |                | 4  |    |    |    |
| AAP268                                   | Research work of a master's student, including internship and completion of a master's thesis | RWMS UC | 4  |     |       |     |                |    | 4  |    |    |
| AAP251                                   | Research work of a master's student, including internship and completion of a master's thesis | RWMS UC | 2  |     |       |     |                |    |    | 2  |    |
| AAP255                                   | Research work of a master's student, including internship and completion of a master's thesis | RWMS UC | 14 |     |       |     |                |    |    |    | 14 |
| <b>M-6. Module of final attestation</b>  |                                                                                               |         |    |     |       |     |                |    |    |    |    |
| ECA212                                   | Preparation and defense of a master's thesis                                                  | FA      | 8  |     |       |     |                |    |    | 8  |    |
| <b>Total based on UNIVERSITY:</b>        |                                                                                               |         |    |     |       |     |                | 30 | 30 | 30 | 30 |
|                                          |                                                                                               |         |    |     |       |     |                | 60 |    | 60 |    |

| Number of credits for the entire period of study |                                        |         |                           |                           |       |
|--------------------------------------------------|----------------------------------------|---------|---------------------------|---------------------------|-------|
| Cycle code                                       | Cycles of disciplines                  | Credits |                           |                           |       |
|                                                  |                                        |         | university component (UC) | component of choice (CCH) | Total |
| BD                                               | Cycle of basic disciplines             |         | 20                        | 15                        | 35    |
| PD                                               | Cycle of profile disciplines           |         | 4                         | 35                        | 53    |
|                                                  | <b>Total for theoretical training:</b> | 0       | 24                        | 50                        | 88    |
|                                                  | RWMS                                   |         |                           |                           | 24    |
| FA                                               | Final attestation                      | 8       |                           |                           | 8     |
|                                                  | <b>TOTAL:</b>                          | 8       | 24                        | 50                        | 120   |

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № 12 " 22 " april 2024 y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 6 "19" april 2024 y.

Decision of the Academic Council of the Institute of A&IT. Protocol № 8 from "29" february 2024 y.

Vice-Rector for Academic Affairs

R.K. Uskenbayeva

Acting Directors of the Institute of Automation and Information Technology

Z.B. Kalpeyeva

Head of the Department of Robotics and Automation Equipment

K.A. Ozhikenov

Specialty Council representative from employers

A.K. Dzhumagulov