SATBAYEV UNIVERSITY

Institute of «Automation and Information Technology»
Department «Robotics and Engineering Tools of Automation»

EDUCATIONAL PROGRAM
7M07106 «Biomedical Engineering»

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 2025

Educational program 7M07106 «Biomedical Engineering» was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes #10 dated 06.03.2025

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

Minutes #3 dated 20.12.2024

Educational program 7M07106 «Biomedical Engineering» was developed by Academic committee based on direction 7M071 «Engineering and engineering trades»

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
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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

Training of specialists in the field of medical and environmental equipment and technologies, the creation and maintenance of tools for diagnosis, treatment, rehabilitation and prevention of human diseases and development of software for solving problems of medical and biological practice.

Master's degree in the field of training "Biomedical Engineering" 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:

-development of programs for scientific research and technical development, preparation of individual tasks for performers;

- collection, processing and systematization of scientific and technical information on the topic of planned research, selection of methods and tools for solving formulated tasks, preparation of tasks for performers;

- mathematical modeling of research technologies for biological objects and biotechnical systems for various purposes using standard software tools;

- development of physical, phenomenological, mathematical and information-structural models of biological objects and processes, assessment of their adequacy, determination of a set of independent indicators that characterize the studied biological object and process;

- organization and participation in conducting biomedical, environmental and ergonomic experiments, collection, processing, systematization and analysis of research results;

- preparation of scientific and technical reports in accordance with the requirements of regulatory documents, preparation of reviews and preparation of publications based on the results of conducted biomedical and environmental studies;

- analysis of patent materials and preparation of applications for inventions and industrial designs;

design and development activities:

- analysis of the state of scientific and technical problems by selecting, studying and analyzing literary and patent sources in the field of biotechnical systems and technologies;

- determination of the purpose, setting of design tasks, preparation of technical specifications for the performance of design works in the field of biotechnical systems and technologies;

- design of devices, devices, systems and complexes for biomedical and environmental purposes taking into account the specified requirements;

- development of design documentation in accordance with methodological and regulatory requirements.

organizational and managerial activities:

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

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

- control over the implementation of measures to prevent industrial injuries, occupational diseases, and prevent environmental violations in the process of research and operation биofbiological medical systems;

design and technological activities:

- development of technical specifications for the design of technological processes and production schemes for biomedical and environmental equipment using automated systems of technological pre-production;

- design of technological processes for the production of biomedical and environmental equipment using automated systems of technological pre-production;

- development of technological documentation for designed devices, devices, systems and complexes for biotechnical, medical and environmental purposes;

- ensuring the manufacturability of products and manufacturing processes, assessing the economic efficiency of manufacturing processes for biomedical and environmental equipment, as well as biotechnical systems in other areas;

- author's support of the developed devices, devices, systems and complexes at the design and production stages;

installation and commissioning activities:

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

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

service and maintenance activities:

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

- preventive control of technical condition and functional diagnostics of biomedical systems for various purposes, as well as their individual subsystems;

- preparation of operating instructions for biomedical 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;

The objects of professional activity of the graduate are:

- biomedical engineering, including information-sensory, Executive and control modules, their mathematical, algorithmic and software, methods and means of their design, modeling, experimental research and design;

- theoretical and experimental studies, analysis of signals, analytical relation for the optimum processing of multidimensional signals, mathematical foundations of pattern recognition, processing, identification and synthesis of speech signals, problem-oriented software systems in biomedical practice, the kinds of provisions for biomedical research, tprinciple that gainss structuress the problem-oriented system, pmessenge processing of diagnostic information in real time, toomplex for

the collection, analysis, processing and storage of biomedical information; data and knowledge bases, systems of forecasting and decision-making software systems, health-technical support of medical institutions.

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:

Training highly qualified specialists in biomedical engineering capable of applying modern technologies and sustainable development methods, ensuring the digitalization of biomedical equipment, environmental safety, and the integration of innovative solutions into healthcare.

Tasks of EP:

- development of students through research activities, critical thinking, development of professionally oriented skills and abilities;
- using highly professional experience of teaching undergraduates in various educational environments;
- training a new competitive generation of technical specialists for the labor market;
- developing an environment that welcomes and supports people from different cultures, and creating an atmosphere of striving for knowledge, academic integration and intellectual motivation;
- conducting research, conducting educational activities based on world best practices, and developing their own brand 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 for the economy and business sector;
- 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;
- developing competencies in digital technologies and automated systems for biomedical equipment;
- strengthening interdisciplinary knowledge in biomedical engineering, sustainable development, and ecology;
- implementing international standards and approaches in biomedical technologies;
- promoting the practical application of artificial intelligence in biomedicine;
- teaching innovative design and research activities in biomedical-technical systems.

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 manufactured biomedical products
S-4	Readiness to lead and participate in the preparation of a feasibility study for projects to create biomedical systems, their subsystems and individual modules
S-5	Ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities
Professional competencies (PC)	
PC-1	Ability to analyze literature data and, based on the analysis, be able to identify and experimentally implement possible ways to improve biomedical systems
PC-2	Ability to conduct professional written and oral communication with all stakeholders in the field of biomedical engineering
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 biomedical engineering and modernize existing biomedical 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 biomedical devices and devices
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	The ability to create adaptive and robust control systems of biotechnical objects
PC-9	Ability to implement scientific results in the production of biomedical products

3. Requirements for evaluating the educational program learning outcomes

Learning outcomes include knowledge, skills, and competencies and are defined both for the educational program as a whole and for its individual modules, disciplines, or assignments. The main task at this stage is to select assessment methods and tools for all types of control, which can be used to most effectively assess the achievement of planned learning outcomes at the discipline level.

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established standard and confirm the level of English language proficiency with a certificate or diplomas of the established standard. The procedure for admission of citizens to the magistracy is established in accordance with the "Standard rules for admission to study in educational organizations that implement educational programs of postgraduate education." The formation of a contingent of undergraduates is carried out through the placement of a state educational order for the training of scientific and pedagogical personnel, as well as tuition fees at the expense of citizens' own funds and other sources. The State provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive this level of education for the first time. At the entrance, a master's student must have all the prerequisites necessary to master the relevant Master's degree program. The list of necessary prerequisites is determined by the higher education institution independently. In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a fee basis.

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	7M07106 «Biomedical Engineering»
5	Short description of educational program	Training of specialists in the field of medical and environmental equipment and technologies, the creation and maintenance of tools for diagnosis, treatment, rehabilitation and prevention of human diseases and development of software for solving problems of medical and biological practice.
6	Purpose of EP	The purpose of the educational program is training highly qualified specialists in biomedical engineering capable of applying modern technologies and sustainable development methods, ensuring the digitalization of biomedical equipment, environmental safety, and the integration of innovative solutions into healthcare
7	Type of EP	New
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	No
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 - Apply methods and techniques of managing a medical-technical enterprise, organize and carry out work on the purchase and equipping of medical and preventive institutions with modern medical equipment, their operation, installation and commissioning. Develop a marketing package. EO2 – Demonstrate professional written and oral communication skills, as well as critical thinking and interdisciplinary problem solving skills. EO3 – 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. EO4 – Applying digital technologies and sustainable management methods in biomedical engineering, including artificial intelligence and machine learning. EO5 – Design modern and reliable blocks and devices, intelligently controlled executive, information-sensor and navigation modules of biomedical devices and

		devices and carry out comprehensive research, including interdisciplinary, based on a holistic systematic scientific worldview using knowledge in the field of history and philosophy of science. EO6 – Formulate innovative tasks in the field of biomedical engineering and apply project management methods for their implementation, evaluate the quality of the project management system, analyze the effectiveness of business processes, use software products to perform project management tasks. EO7 – Demonstrate a steady interest in self-learning and learning of both mentees and colleagues, guide and advise them throughout the entire period of professional activity. EO8 – Demonstrate teaching and mentoring skills in secondary and higher education institutions using modern technologies and teaching methods.
13	Education form	full-time
14	Period of training	2 year
15	Amount of credits	120
16	Languages of instruction	russian, kazakh, english
17	Academic degree awarded	Master of Technical Sciences
18	Developer and author	Ozhikenov K.A.

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	EO 7	EO 8
		Cycle of basic disciplines University component									
1.	Foreign language (professional)	The course is aimed at studying the main problems of scientific knowledge in the context of its historical development and philosophical understanding, the evolution of scientific theories, principles and methods of scientific research in the historical construction of scientific paintings of the world. The discipline will help to master the skills of developing critical and constructive scientific thinking based on research on the history and philosophy of science. At the end of the course, undergraduates will learn to analyze the ideological and methodological problems of science and engineering and technical activities in building Kazakhstan's science and the prospects for its development.	3		v						
2.	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image, analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.	3			v					
3.	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of 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	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates	3							v	v

		learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select the content of training sessions. Organize the educational process on the basis of credit technology of education.									
5.	Pedagogical practice	To know the history of the development of general psychological concepts of cognitive processes, modern theories and problems of the systematic organization of cognitive processes. Be able to analyze, compare and generalize the results of theoretical and applied research in the field of general psychology; apply modern methods and techniques of teaching technical disciplines; use the acquired knowledge for independent development and application of ideas in the context of scientific research; critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena. Acquisition of research skills, solving standard scientific tasks; implementation of educational and pedagogical activities on credit technology of education; methods of teaching professional disciplines	8			v					v
Cycle of basic disciplines Component of choice											
6.	Biotechnical systems and technologies	The purpose of studying the discipline is to study methods and techniques of analysis and creation of biotechnical systems and technologies. The processes of interaction of biological and technical systems are considered in detail. To show the possibility of applying biotechnical systems and technologies in various fields of biology and medicine. The features of displaying information about the state of the body and the parameters of impacts in the composition of biotechnical systems, the main modern trends in the development of biotechnical technologies are studied.	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	v			
8.	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				
9.	Methods for solving inventive	Purpose: the development of the discipline is the development of skills to	5				v				

	tasks	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.									
10.	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5					v			
11.	Mathematical statistics and probability theory in biomedical research	Purpose: The purpose of the discipline is to study the patterns of random phenomena and their properties, and use them to analyze statistical data. Content: Events. Probability. General properties of probability. The classical definition of probability. Geometric definition of probability. Mathematical expectation. The variance. Covariance. Correlation coefficient practical lesson Mathematical expectation. The variance. Covariance. Correlation coefficient Limit theorems lecture lesson The Law of large numbers. The central limit theorem.	5				v		v		
12.	Modern methods of processing biomedical signals and images	The goal of the discipline is to deepen knowledge of biomedical signal processing methods, provide an advanced study of machine learning methods and sustainable big data analysis, implement algorithms for predicting biomedical conditions based on biomedical data, and master modern approaches to medical image processing, quality improvement, and diagnostic analysis.	5				v				
13.	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5	v		v				v	
Cycle of profile disciplines University component											
14.	Computer technologies in biomedical research	The purpose of studying the discipline is to form the necessary knowledge about technical and software tools for biomedical research, about the creation of algorithms for processing biosignals, ideas about methods and technologies for processing physical information received	5				v				

		from a biological object, about computer systems as a tool for working with information, about methods for automating the creation and maintenance of software.									
15.	Research practice	Formation of professional skills necessary for the successful implementation of research activities, mastering research technology; introducing undergraduates to direct practical activities in order to acquire the professional qualities of a future specialist; organization of interaction and communication of undergraduates with specialists of their future specialty for professional adaptation, the development of a creative and research approach to future professional activities among undergraduates, the acquisition of skills in analyzing the results of their work, the formation of the need for self-education.	4				√		√		
Cycle of profile disciplines Component of choice											
16.	Control in biotechnical and medical systems	The purpose of studying the discipline is to study the theory and methods of automatic and automated control used in the creation of biotechnical systems for various purposes and automated health management systems. Forms knowledge, skills, skills and competencies on control systems of biotechnical systems; beliefs about the need for the development of automatic biotechnical systems to ensure human life; the use of information tools necessary for future professional activity.	5				√	√			
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					√			
18.	Biomedical measuring information systems	The purpose of studying the discipline is to gain new knowledge through the development of fundamental and applied scientific research in the field of biomedical engineering; preparation for research activities, the objects of which are devices, systems and complexes of biomedical purposes, methods and technologies for performing medical, biological, environmental research; automated systems for processing biomedical information; biotechnical control systems.	5				√	√			
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	5				√				

		in information and measurement systems; metrological providing systems; sources, types and performance indicators of information and measurement systems									
20.	Project Management	Goal: Gaining knowledge about the components and methods of project management based on modern models and standards. Objectives: study of behavioral models of project-oriented management of business development; mastering international standards PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management; analysis of the features of organizational management of business development through the integration of strategic, project and operational management.	5						v		
21.	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			
22.	Verification, safety and reliability of medical equipment	The purpose of studying the discipline is the formation of knowledge about the operation and maintenance of medical devices, biotechnical systems and devices in the conditions of biomedical organizations, training in the principles of ensuring safe living conditions in the development, production and operation of biomedical devices, complexes and systems, training in how to apply methods of organizing routine maintenance, verification and certification of medical equipment.	5					v			
23.	Filtering and detection of biomedical signals	Purpose: The purpose of the discipline is to study methods and algorithms for processing biomedical signals and data used in the creation of biotechnical and medical systems. Contents: Studying the discipline gives undergraduates the basics of engineering and theoretical skills in processing and analyzing biomedical information. The use of computer technologies for filtering and eliminating artifacts, for identifying discrete epochs of a biomedical signal, for classifying images and making diagnostic decisions.	5				v				
24.	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,	5			v					

		technology and production.									
25.	Fundamentals of marketing and management in medical and technical enterprises	The purpose of studying the discipline is the formation of knowledge in the field of operation and maintenance of the latest medical equipment and the specifics of medical devices as a special type of industrial goods, as well as the acquisition of practical teamwork skills, problem analysis and the development of management solutions. Study of the basic concepts and categories, as well as trends in the development of management and marketing at medical and technical enterprises	5			v					
26.	Medical information systems	The purpose of studying the discipline is to get acquainted with the principles, methods and means of building medical information systems, medical information resources. The study of ways and means of interaction of medical information systems using modern computer technology and new information technologies. Acquisition of skills in designing, developing, implementing and operating medical information systems in medical institutions of various profiles	5				v	v			
27.	Automated design of medical equipment	The purpose of studying the discipline is to study the methodology of modern methods of designing medical equipment. After studying, the master's student systematizes, consolidates and deepens the theoretical knowledge and skills acquired, applies this knowledge at the stage of technical design, developing skills for independent work, conducting theoretical and experimental research with the involvement of means and methods of microprocessor technology.	5					v			
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.	Quality management of production and service of medical equipment	The purpose of studying the discipline is to study the quality assessment model of the process of repair and maintenance of medical equipment. To identify the signs of quality assessment at enterprises for the repair and maintenance of medical equipment. The study of the quality management system of processes in the industrial, commercial and educational spheres. The product quality management system is a set of management bodies and management facilities, measures, methods and means aimed at establishing, ensuring and maintaining a high level of product quality.	5	v							
30.	Organization and planning of the production of medical equipment	The purpose of studying the discipline is to study in the interrelation of the most important issues and factors of the science of the organization of the production of medical equipment, ensuring the effective functioning	5	v		v					

		of an industrial enterprise – the primary link of the material production of medical equipment. The principles of the organization of production processes of medical equipment are studied. Indicators of the organization of the production process. The concept of the organizational type of production and its defining features of medical equipment. Organization of research and development work. Planning of technical training									
31.	Artificial intelligence in medicine	The purpose of studying the discipline is to study the essence and principles of biomedical information processing. Intelligent signal processing methods in biomedicine. Using fuzzy logic theory, wavelet analysis, fractal theory, expert approach and artificial neural network theory to solve biomedical signal processing problems. Definition and classification of biomedical images. Development and operation of medical information systems. Modern methods of processing biomedical images.	5				v				
32.	Intelligent control technology	Studying the theoretical foundations of artificial intelligence, neural network technologies of intelligent systems, technologies for constructing control systems with fuzzy logic, rules of fuzzy logic, technologies for creating a knowledge base, expert control systems, adaptive control systems, theoretical problems and techniques of intelligent systems, etc. These knowledge are necessary for further understanding of the principles of construction of robotic systems	5				v	v			
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	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		

5. Curriculum of educational program

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

APPROVED
Chairman of the Management Board-
Rector of KazNRTU named after K.Satpayev
_____ M.M. Begentaev
«___» _____ 2025 y.

CURRICULUM
of Educational Program on enrollment for 2025-2026 academic year
Educational program 7M07106 - "Biomedical engineering"
Group of educational programs

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 training based on courses and semesters			
								I 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		
optional component											
ROB266	Biotechnical systems and technologies	BD CCH	5	150	2/0/1	105	E	5			
ROB204	Intelligent information management and processing systems				2/1/0						
ROB262	Application of methods of technical creativity in innovation	BD CCH	5	150	2/0/1	105	E	5			
ROB292	Methods for solving inventive tasks										
MNG781	Intellectual property and scientific research										
ROB293	Mathematical statistics and probability theory in biomedical research	BD CCH	5	150	2/0/1	105	E		5		
ROB219	Modern methods of processing biomedical signals and images										
MNG782	Sustainable development strategies										
M-2.Module of theoretical foundations of management											
ROB267	Computer technologies in biomedical research	PD UC	5	150	2/0/1	105	E	5			
ROB554	Management in biotechnical and medical systems	PD CCH	5	150	2/0/1	105	E		5		
ROB203	Intelligent management in conditions of uncertainty										
ROB261	Biomedical measurement information systems	PD CCH	5	150	2/0/1	105	E			5	
ROB224	Technical means of information and measuring systems										
MNG705	Project management										
M-3. Control Design Module (optional component)											
ROB277	Diagnostics and reliability of technical systems and devices	PD CCH	5	150	2/0/1	105	E	5			

ROB278	Verification, safety and reliability of medical equipment										
ROB298	Filtering and detection of biomedical signals	PD CCH	5	150	2/0/1	105	E		5		
ROB279	Digital processing of measurement information										
ROB271	Fundamentals of marketing and management at medical and technical enterprises	PD CCH	5	150	2/0/1	105	Э		5		
ROB287	Medical information systems										
ROB282	Computer-aided design of medical equipment	PD CCH	5	150	2/0/1	105	Э			5	
ROB239	Design of microprocessor and microcontroller systems				2/1/0						
ROB246	Quality management of production and service of medical equipment	PD CCH	5	150	2/0/1	105	E			5	
ROB247	Organization and planning of medical equipment production										
ROB268	Artificial intelligence in medicine	PD CCH	5	150	2/0/1	105	E			5	
ROB225	Intelligent control technology										
ROB710	Planning an experiment	PD CCH	4	120	0/0/3	75	course project				4
ROB711	Statistical methods in research										
M-4. Practice-oriented module											
AAP273	Pedagogical practice	BD UC	8							8	
AAP256	Research practice	PD, CCH	4								4
M-5. Experimental research module											
AAP268	Research work of a master's student, including internship and completion of a master's thesis	RW MS UC	4					4			
AAP268	Research work of a master's student, including internship and completion of a master's thesis	RW MS UC	4						4		
AAP251	Research work of a master's student, including internship and completion of a master's thesis	RW MS UC	2							2	
AAP255	Research work of a master's student, including internship and completion of a master's thesis	RW MS UC	14								14
M-6. Module of final attestation											
ECA212	Preparation and defense of a master's thesis	FA	8								8
	Total based on UNIVERSITY:							30	30	30	30
								60		**60**	

Number of credits for the entire period of study		
Cycle	**Cycles of disciplines**	**Credits**

code			university component	component of choice	Total
BD	Cycle of basic disciplines		20	15	35
PD	Cycle of profile disciplines		9	44	53
	Total for theoretical training:	***0***	***29***	***59***	***88***
	RWMS				***24***
FA	Final attestation	8			8
	TOTAL:	**8**	**29**	**59**	**120**

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № __ from "___" _____ 2025 y.
Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № "__" _____2025 y.
Decision of the Academic Council of the Institute of A&IT. Protocol № __ from "___" _____ 2025 y.

Vice-Rector for Academic Affairs _____ **R.K. Uskenbayeva**

Acting Directors of the Institute of Automation and Information Technology _____ **E.G. Chinibayev**

Head of the Department of Robotics and Automation Equipment _____ **K.A. Ozhikenov**

Specialty Council representative from employers _____ **A.K. Dzhumagulov**