Satbayev University
A. Burkitbayev Institute of Industrial Automation and Digitalization
The Department "Robotics and Engineering Tools of Automation»

CURRICULUM PROGRAM

"ROBOTICS AND MECHATRONICS"
Master of engineering and technology
of the educational program "7M07134-Robotics and mechatronics"

on the basis of the vitiated Specialty Classifier: 6M071600 - Instrumentation

1st edition
in accordance with the State Educational Standard of Higher Education 2018

Almaty 2020

The program is drawn up and signed by the parties:

from Satbayev University:

1. Head of the Department of Robotics and Engineering Tools of Automation (R&ETA), Ph.D. K. Ozhikenov

2. Director of the Institute of Industrial Automation and Digitalization, PhD B. Omarbekov

3. Chairman of the Educational and Methodological Group of the Department of "R&ETA", Ph.D, Associate Professor Zh. Ualiyev

From the employer:
Director of LLP "MedRemZavodHolding" A. K. Dzhumagulov
Deputy Director for IIT of LLP "Saiman Corporation" K. I. Baibekov

Approved at the meeting of the Educational and Methodological Council of the Satbayev University, (Protocol #3 of 19.12.2018)

Qualification:
Level 7 of the National Qualifications Framework:
7M07 Engineering and Engineering (Master's degree):
7M071 Robotics and Mechatronics

Professional competencies: in the field of research methodology; in the field of scientific activity in higher educational institutions; in matters of modern production technologies; in the implementation of scientific projects and research in the professional field; in the field of information analysis.

Brief description of the program:

1 Objectives of the educational program

Purposes of OP "Robotics and mechatronics" are:

meeting the needs of students in intellectual, creative and professional development by acquiring knowledge and skills in the area of robotic and mechatronic systems;

organization of graduate education that allows all students to continue their education with the aim of obtaining a PhD diploma in the field of robotic and mechatronic systems, and to further self-improvement, in order to successfully build a career in manufacturing.

meeting the needs of the Republic of Kazakhstan for qualified personnel by training specialists in the use and maintenance of robotic and mechatronic systems and specialists with skills in designing computer-controlled equipment in connection with the industrialization and digitalization of industry.

2 Types of employment

Types of professional activities that graduates who have completed the master's program are preparing for:

- scientific research;
- design and development;
- organizational and management;
- installation and commissioning;
- service and maintenance.

A master's degree in Robotics and mechatronics should be prepared to solve professional problems in accordance with the profile of the master's program and 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 basis of robotics and mechatronics, compilation and publication of reviews and abstracts;

- conducting theoretical and experimental research in the field of developing new models and improving existing robotic and mechatronic systems, their modules and subsystems, searching for new ways to control and process information using artificial intelligence methods, fuzzy logic, multi-agent control methods, artificial neural and neural networks;

- conducting patent research that accompanies the development of new robotic and mechatronic systems in order to protect intellectual property objects and the results of research and development;

- 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 performing development work;

- organizing and conducting experiments on existing robotic and mechatronic systems, their subsystems and individual modules in order to determine their effectiveness and identify ways to improve, processing the results of experimental research 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 for projects of new robotic and mechatronic systems, their individual subsystems and modules;

- calculation and research of robotic and mechatronic systems, control, information-sensor and Executive subsystems using mathematical modeling methods, conducting mock-up and testing of existing systems, processing experimental data using 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 systems and information processing;

organizational and management activities:

- development of organizational and technical documentation (work schedules, instructions, plans, estimates) and established reporting on 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 environmental violations in the process of 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 interface of software and hardware complexes with technical objects as part of robotic and mechatronic systems, in testing and commissioning of prototypes of such systems;

service and maintenance activities:

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

- preventive monitoring of the 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 repairs.

3 Objects of professional activity

The objects of professional activity of the graduate are:

- robotic and mechatronic systems, including information-sensor, Executive and control modules, their mathematical, algorithmic and software, methods and tools for their design, modeling, experimental research and design;

- theoretical and experimental research of robotic and mechatronic systems for various purposes.

PASSPORT OF THE EDUCATIONAL PROGRAM

1 Scope and content of the program

The duration of a master's degree is determined by the amount of academic credits earned. When you complete the set amount of academic credits and achieve the expected learning outcomes for a master's degree, the master's degree program is considered fully completed. There are at least 90 academic credits in the specialized master's program with a period of 1.5 years of study.

Planning 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 degree program in the profile direction implements educational programs of postgraduate education for the training of managerial personnel with in-depth professional training.

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

1) theoretical training, including the study of cycles of basic and core disciplines;

2) practical training of undergraduates: various types of practical training, scientific or professional internships;

3) experimental research work, including the implementation of a master's thesis (project) – - for a specialized master's degree

4) final attestation.

The content of the EP "Robotics and mechatronics" within the framework of the 6m071600 - Instrument engineering specialties is implemented in accordance with the credit technology of training and is carried out in the state and Russian languages.

Educational program "Robotics and mechatronics" contains a complete list of academic disciplines, grouped in cycles: basic (BD) and majors (MD) as for higher components (HC) and components of choice (CC), indicating the complexity of each subject in academic hours and credits established by the State compulsory standards of higher and postgraduate education approved by order of MES RK №604 dated October 31, 2018.

The BD cycle includes the study of academic disciplines and professional practice. The MD cycle includes academic disciplines and types of professional practices. The programs of disciplines and modules of the BD and MD cycles are interdisciplinary and multidisciplinary in nature, providing training at the intersection of a number of areas of knowledge.

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

Objectives of the educational program:

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

- use of 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 world best practices, developing their own methodology 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 to organize training on the principle of lifelong learning;
- establishing partnerships with other universities and organizations in order to improve the quality of education, to support technical and cultural ties.

2 Requirements for applicants

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admission of citizens to the master's program is established in accordance with the "Standard rules for admission to training in educational organizations that implement educational programs of postgraduate education".

The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of specialized personnel, as well as paying for training 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 for mastering the corresponding 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 master's student is allowed to master them on a paid basis.

3 Requirements for completing studies and obtaining a diploma

Degree/qualifications awarded: the graduate Of this educational program is awarded the academic degree "master of engineering and technology" in the field.

A graduate who has completed master's programs must have the following General professional competencies:

- the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;

- the ability to independently formulate research goals, establish the sequence of professional tasks;

- the ability to apply in practice knowledge of fundamental and applied sections of disciplines that determine the direction (profile) of the master's program;

- the ability to professionally select and creatively use modern equipment to solve scientific and practical problems;

- the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities;

- proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;

- willingness to lead a team in the field of their professional activities, tolerantly accepting social, ethnic, religious and cultural differences;

- readiness to communicate orally and in writing in a foreign language to solve professional tasks.

A graduate who has completed the master's program must have professional competencies that correspond to the types of professional activities that the master's program focuses on:

research activities:

- the ability to create mathematical models of robotic and mechatronic systems and their subsystems, including Executive, information-sensor and control modules, using methods of formal logic, methods of finite automata, Petri nets, artificial intelligence methods, fuzzy logic, genetic algorithms, artificial neural and neuro-fuzzy networks;

- the ability to use existing software packages and, if necessary, develop new software necessary for information processing and control in robotic and mechatronic systems, as well as for their design;

- the ability to develop experimental models of control, information and Executive modules of robotic and mechatronic systems and conduct their research using modern information technologies;

- the ability to analyze scientific and technical information, summarize domestic and foreign experience in the field of robotics and mechatronics, automation and control tools, and conduct patent search;

- the ability to develop methods of conducting experiments and conduct experiments on existing models and samples of robotic and mechatronic systems and their subsystems, process the results using modern information technologies and technical means;

- readiness to prepare analytical reviews and scientific and technical reports on the results of the work performed, to prepare publications on the results of research and development;

- the ability to put into practice the results of research and development performed individually and as part of a group of performers, to ensure the protection of intellectual property rights;

design and development activities:

- 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;

- ability to prepare technical specifications for the design of robotic and mechatronic systems, their subsystems and individual devices using standard Executive and control devices, automation, measuring and computer equipment, as well as new devices and subsystems;

- the ability to participate in the development of design and design documentation for robotic and mechatronic systems in accordance with existing standards and specifications;

- willingness to develop a methodology for conducting experimental research and testing of a mechatronic or robotic system, the ability to participate in conducting such tests and processing their results;

organizational and managerial activities:

- ability to organize the work of small groups of performers;

- readiness to develop technical documentation (work schedules, instructions, plans, estimates) according to approved forms;

- readiness to apply methods of prevention of industrial injuries, occupational diseases, and prevention of environmental violations;

installation and adjustment activities:

- ability to carry out adjustment, adjustment and adjustment of robotic and mechatronic systems for various purposes;

- readiness to perform debugging of software and hardware complexes and their interface with technical objects as part of robotic and mechatronic systems;

- readiness to participate in testing and commissioning of prototypes of robotic and mechatronic systems;

service and maintenance activities:

- readiness to participate in the development of routine testing programs, verification and assessment of the state of robotic and mechatronic systems for various purposes, as well as their individual subsystems;

- the ability to perform preventive monitoring of the technical condition and functional diagnostics of robotic and mechatronic systems for various purposes, as well as their individual subsystems;

- ability to draw up operating instructions for robotic and mechatronic systems and their hardware and software;

- readiness to make requests for equipment and components, to participate in the preparation of technical documentation for equipment repairs.

4 Working curriculum of the educational program
4.1. Duration of training 1,5 years

MODULAR CURRICULUM

Education program *7M07134 - Robotics and Mechatronics*

Form of study: *full* Duration of training: *1,5 years* *Academic degree: Master of Technical and Technological*

The cycle	Code	Name of disciplines	Semester	Acad. credits	lec.	lab.	Tutorial	IWD	Type of Final assessment	Department
Profile training module (18 credits)										
Mandatory disciplines										
BD 1.2.1	LNG209	Foreign language (professional)	1	6	0	0	2	2	Exam	EL
BD 1.2.2	MNG274	Management	1	6	2	0	1	3	Exam	SD
BD 1.2.4	HUM204	Management psychology	2	4	1	0	1	2	Exam	SECPM
Module of robotic systems (22 credits)										
Elective disciplines										
BD 1.2.2	ROB256	The dynamics of robots	1	6	1	0	1	2	Exam	RaETA
BD 1.2.2.1	ROB258	Control in biotechnical and medical systems	1	6	1	0	1	2	Exam	RaETA
BD 1.2.3	ROB254	Information devices of robots	1	4	1	0	1	2	Exam	RaETA
BD 1.2.3.1	ROB255	Biotechnical systems	1	4	1	0	1	2	Exam	RaETA
PS 1.3.4	ROB235	Digital processing of measurement information	2	6	2	0	1	3	Exam	RaETA
PS 1.3.4.1	ROB248	Verification, safety and reliability of medical equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.6	ROB233	Robot Navigation Systems	2	6	2	0	1	3	Exam	RaETA
PS 1.3.6.1	ROB252	Automated design of medical equipment	2	6	2	0	1	3	Exam	RaETA
Module for planning and designing robotic systems (30 credits)										
Elective disciplines										
PS 1.3.1	ROB234	Mathematical modeling and optimization of motion of multi-tier systems	1	6	2	0	1	3	Exam	RaETA
PS 1.3.1.1	ROB245	Computer technologies in biomedical research	1	6	2	0	1	3	Exam	RaETA
PS 1.3.2	ROB236	Multi-agent robotic systems	1	6	2	0	1	3	Exam	RaETA
PS 1.3.2.1	ROB246	Quality management of medical equipment service	1	6	2	0	1	3	Exam	RaETA
PS 1.3.3	ROB251	Organization and planning of production of mechatronic equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.3.1	ROB243	Biomedical measuring information systems	2	6	2	0	1	3	Exam	RaETA
PS 1.3.5	ROB202	Diagnostics and reliability of technical systems and devices	2	6	2	0	1	3	Exam	RaETA
PS 1.3.5.1	ROB247	Organization and planning of the production of medical equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.7	ROB238	Designing special purpose robotic systems	2	6	2	0	1	3	Exam	RaETA

PS 1.3.7.1	ROB241	Clinical, laboratory and environmental analytical equipment	2	6	2	0	1	3	Exam	RaETA
Practice-oriented module (10 credits)										
PS 2.3.1	AAP246	Work placement	3	10					Report	RaETA
Experimental research module (18 credits)										
MSERW	AAP247	Master's student experimental research work, including internship and master's project implementation	2	4					Report	RaETA
MSERW	AAP245	Master's student experimental research work, including internship and master's project implementation	3	14					Report	RaETA
Module of final attestation (12 credits)										
FA	ECA205	Registration and defense of the master's thesis	4	12					Defense of dissertation	RaETA
Total				**101**						

5 Descriptors of the level and scope of knowledge, skills and competencies

Requirements for the master's degree level are determined on the basis of the Dublin descriptors of the second level of higher education (master's degree) and reflect the acquired competencies expressed in the achieved learning outcomes.

Learning outcomes are formulated at the level of the entire master's degree program, as well as at the level of individual modules or academic discipline.

Descriptors reflect learning outcomes that characterize the student's abilities:

1) demonstrate developing knowledge and understanding in the field of robotics and mechatronics under study, based on advanced knowledge of this field of robotics and mechatronics in the development and application of ideas used in research;

2) apply your knowledge, understanding, and skills at a professional level to solve problems in a new environment, in a broader interdisciplinary context;

3) collect and interpret information to form judgments based on social, ethical and scientific conclusions;

4) clearly and unambiguously communicate information, ideas, conclusions, problems and solutions, both to specialists and non-specialists;

5) training skills necessary for independent continuation of further training in the field of robotics and mechatronics.

6 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 (SMS)	
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
Professional competencies (PC)	
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

The matrix of competencies of the educational program "Robotics and mechatronics»

Discipline index	Name of the discipline	Universal, social and ethical						Special and managerial					Professional								
		U-1	U-2	U-3	U-4	U-5	U-6	S-1	S-2	S-3	S-4	S-5	PC-1	PC -2	PC -3	PC -4	PC -5	PC -6	PC -7	PC -8	PC -9
Required component																					
LNG205	Foreign language (professional)	x											x	x							
ROB232	Information devices and systems												x				x	x	x		
ROB236	Multi-agent robotic systems												x				x	x	x	x	
ROB228	Dynamics of robots												x				x	x		x	
ROB237	Managing mobile robots in an unknown environment												x				x	x	x		
ROB202	Diagnostics and reliability of technical systems and devices												x				x			x	
ROB233	Robot navigation systems												x				x	x	x	x	
ROB250	Information topologies and networks												x				x	x	x	x	
ROB234	Mathematical modeling and optimization of multi-link systems movement									X			x				x	x		x	x
ROB238	Design of special-purpose robotic systems									X			x				x	x	x	x	x
ROB218	Robust systems and adaptive control												x				x	x	x	x	
ROB235	Digital processing of measurement information												x				x	x	x	x	
State final attestation																					
ECA205	Preparation and defense of a master's thesis (PDMT)	x	x	x	x	x	x	x	x	X	x	x	x	x	x	x	x	x	x	x	x
Additional types of training																					
AAP242	Experimental research work of a master's student									X	x		x				x	x	x	x	x
AAP244	Internship	x	x	x	x	x	x	x	x	X	x	x			x	x					

7 Annex to the certificate according to the standard ECTS

The app is developed according to the standards of the European Commission, the Council of Europe and UNESCO/CEPES. This document serves only for academic recognition and is not an official confirmation of the document of education. It is not valid without a higher education diploma. The purpose of completing the European application is to provide sufficient information about the diploma holder, the qualification they have received, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model that will be used for transferring ratings uses the European credit transfer or transfer system (ECTS).

The European diploma Supplement provides an opportunity to continue education at foreign universities, as well as to confirm national higher education for foreign employers. When traveling abroad for professional recognition, additional legalization of

the diploma of education will be required. The European diploma Supplement is completed in English upon individual request and is issued free of charge.

8 Brief description of courses

Foreign language (professional)
CODE - LNG205
CREDIT – 5
PREREQUISITE – Academic English, Business English, IELTS 5.0-5.5

COURSE GOALS AND OBJECTIVES
Thanks to this course, you will master specific terminology, be able to read specialized literature, and gain the knowledge necessary for effective oral and written communication in a foreign language in your professional activity.
BRIEF DESCRIPTION OF THE COURSE
In the course of training, students gain knowledge of a foreign language, including proficiency in specialized vocabulary, necessary for effective oral and written communication in a foreign language in their professional activities. Practical tasks and methods for developing the required language skills in the learning process include: case studies and role-playing games, dialogues, discussions, presentations, listening tasks, working in pairs or in groups, performing various written tasks, grammar tasks and explanations.
KNOWLEDGE, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, the student will expand their professional vocabulary, possess the skills to carry out effective communication in a professional environment, the ability to correctly Express thoughts in oral and written speech, understand specific terminology and read specialized literature.

Project management
CODE - MNG230
CREDIT – 3
PREREQUISITE-the Discipline "Project management" is based on the knowledge obtained as a result of studying disciplines in undergraduate courses

COURSE GOALS AND OBJECTIVES
The purpose of teaching the discipline "Project management" is to master the methodology of project management in various fields of activity, to foster a culture that is adequate to modern project management and information technologies, to create conditions for the introduction of new information technologies in the field of project implementation. The course is based on international recommendations for project management (Project Management Body of Knowledge).
BRIEF description Of the COURSE the content of the discipline is aimed at studying modern concepts, methods, and tools of project management in order to apply them in the further practical activities of a specialist to solve problems of project planning and execution.
KNOWLEDGE, SKILLS, SKILLS AT the end of the COURSE
to be able to:
- prepare documents for the project initialization stage, such as a feasibility study, project Charter, etc.
- develop and analyze documents related to project planning, apply various methods of decision support;
- promptly monitor the completion of work and track deadlines;
- to select personnel, to resolve differences between team members.;
- manage the risks that arise during the implementation of projects.
knowledge gained during the course of the discipline:
- Modern standards in the field of project management and their characteristics;
- PMI approach to project management;
- Planning of investment activity;
- Accounting for project risks;
- Methods for optimizing the use of available resources;
- Ways to resolve conflict situations;
- Analysis of actual indicators for timely adjustment of the progress of work.
skills:
- project management in accordance with modern project management requirements-use MS Project software in the project management process.

Information devices of robots
CODE-ROB254
CREDIT – 4
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES
The purpose of mastering the discipline "robot Information devices" is to study the principles of building robot information systems, their sensitive elements, measuring circuits and amplifiers; the physical principles used in the creation of various sensors are considered, and mathematical dependencies are studied that allow calculating the main parameters of sensitive elements. BRIEF DESCRIPTION OF THE COURSE
Introduction. Elements of information systems. Measurement of kinetic and dynamic values. Location information systems. Technical vision systems. Tactile systems. KNOWLEDGE, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, a master's student should:
know:
- modern research methods;
- stages of implementation of projects in the field of robotics and mechatronics;
- basic principles of scientific and technical information search.
be able to:
- learn independently using modern information technologies;
- use new knowledge and skills in practical activities;
- use existing software packages and, if necessary, develop new software;
to possess:
- skills distribution of the work;
- skills to implement the acquired knowledge in the practical implementation of projects;
- skills in working with modern research tools for robotic systems.

Robot navigation systems
CODE-ROB233
CREDIT – 4
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

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. Teach them to understand the purpose of robot navigation systems and apply modern robot navigation systems and tools.

BRIEF DESCRIPTION OF THE COURSE

To study this discipline, you need to know the basics of the disciplines "Linear algebra", "Applied mathematics", "Physics", "Theoretical mechanics", "Theoretical foundations of electrical engineering".

Inertial orientation and navigation system (ISON) for manipulative and mobile robots. Structure and purpose of the ISON. Structure and purpose of the sensitive element block (BCE). Kinematic parameters of a moving object, measured using ISON. Statement of the problem of inertial orientation and navigation of a moving object. Orientation and navigation algorithms for determining the kinematic parameters of a moving object using ISON. Derivation of the equation for the kinematic error of ISON.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, the student must:

know:

- the principles of operation and mathematical description of the constituent parts of the navigation systems of robots, the nature and significance of information in the development of the modern information society, satellite navigation system,

to be able to:

- to apply theoretical knowledge in solving practical problems of navigation of robots
- apply the necessary knowledge to build mathematical models, to set goals and choose ways to achieve it, to work in a team,

to own:

- skills in developing robot navigation systems; the ability to analyze the state of a scientific and technical problem by selecting, studying and analyzing literary and patent sources;
- skills of working with information in global computer networks; ability to generalize, analyze, and perceive information;
- skills of cooperation with colleagues; skills of working with a computer as a means of information management.

Mathematical modeling and optimization of multi-link systems movement
CODE-ROB234
CREDIT – 5
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

The purpose of teaching the discipline is to study the principles of modeling the movement of multi-link systems, which are the majority of mechatronic systems that are multi-link, such as manipulators of industrial robots, construction cranes, single-bucket excavators, etc., at the design stage. Study the main elements of the SimMechanics library. and the principles of forming models of spatial mechanisms and machines in the SimMechanics environment, visualizing the movements of spatial mechanisms and machines using the built-in SimMechanics tools.

BRIEF DESCRIPTION OF THE COURSE

The course "Mathematical modeling and optimization of motion of multi-link systems" is designed to study the principles of design and analysis of mechanical systems (for example, various kinematic connections) using the developed special physical and mathematical apparatus SimMechanics, an extension package of the Simulink system for physical modeling. This technical design and simulation of mechanical systems (within the laws of theoretical mechanics) SimMechanics allows you to model translational and rotational motion in three planes. SimMechanics contains a set of tools for setting link parameters (mass, moments of inertia, geometric parameters), kinematic constraints, local coordinate systems, and methods for setting and measuring movements.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of studying the discipline, a master's student should:

Know:

- functional purposes of methods for mathematical modeling and optimization of motion of multi-link mechatronics systems.

Be able to:

develop new approaches to mathematical modeling and optimization of the movement of multi-link mechatronics systems .

Own:

- skills to implement the acquired knowledge in the practical implementation of projects.

Multi-agent robotic systems
CODE-ROB236
CREDIT – 5
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

The study of multi-agent systems, which is 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, which lay the principle of autonomy of individual parts of the program that function together in a distributed system, where many interrelated computing processes are simultaneously running on programs called multi-agents.

BRIEF DESCRIPTION OF THE COURSE

This discipline provides the study of a wide range of problems related to the use of special programs for multi-agent systems that allow solving artificial intelligence problems in modern conditions. It provides a holistic view of the content of the multi-agent approach, the procedure for its implementation and the use of analysis results in management processes. New models are considered in the form of distributed dynamic environments and intelligent agents that provide an adequate reflection of the increasing complexity of making decisions on business management in conditions of uncertainty and conflicts, event-based, situational, high connectivity with the use of multi-agent robotic systems.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, a master's student should:

know:

- General principles of building multi-agent robotic systems;
- methodology, methods and models for the formation of multi-agent robotic systems;

be able to:

- synthesize multi-agent robotic systems.

Possess:

- methods of using multi-agent robotic systems.

Organization and planning of production of mechatronic equipment
CODE-ROB251
CREDIT – 4
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

The purpose of the discipline is to study the most important issues and factors of the science of production organization that ensure the effective functioning of an industrial enterprise – the primary link of material production.

Objectives of the discipline:

– master the basics of production organization;

– thoroughly study the organization of production processes;

learn the basics of organizing production infrastructure and auxiliary workshops that provide services to the enterprise;

study the organization, planning and management of the preparation and development of new equipment in the enterprise.

BRIEF DESCRIPTION OF THE COURSE

The essence and objectives of the organization of production. The concept of the General and production structure of the enterprise. General characteristics of the production process and its structure. The concept of the organizational type of production and its defining features. Technological preparation of production, tasks, content and procedure for its implementation. Product quality, indicators and assessment of its level. Structure and content of the environmental protection plan.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, a master's student must:

know:

– General patterns of functioning and development of the organization(enterprise), the relationship of the main elements;

be able to:

– apply the tools of organization and production planning as a discipline in specific practical situations;

have the skills to:

– use the tools of enterprise Economics (organization and production planning) for practical tasks of enterprise management.

Digital processing of measurement information
CODE-ROB235
CREDIT – 4
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

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.

BRIEF DESCRIPTION OF THE COURSE

This discipline provides the study of a wide range of problems related to the conversion of analog signals into digital signals, as well as various binary codes that provide high reliability and reliability of transmitted information. Purpose and applications of digital signals and digital signal processing (DSP) systems. Kotelnikov's Theorem.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, a master's student should:

know

- the advantages of digital signals and their role in the created robotic and mechatronic systems and complexes;
- mathematical apparatus for describing digital signals and systems;
- various methods and algorithms for digital filtering;
- a modern element base for implementing digital signal processing systems.

be able

- to mathematically describe digital signals and their processing systems;
- to use the software application to implement the systems and digital signal processing.
- possess:
- mathematical and algorithmic methods for designing digital signal processing systems;
- information technologies and software for the design of digital signal processing units and systems used in robotic and mechatronic systems and complexes.

Dynamics of robots
CODE-ROB228
CREDIT – 5
PREREQUISITE-physics, mathematics

COURSE GOALS AND OBJECTIVES

The discipline is aimed at preparing undergraduates to perform research and design functions related to the study and modeling of dynamics of robotic systems and components of automated production systems.

BRIEF DESCRIPTION OF THE COURSE

Basic concepts of system dynamics. Basic laws of dynamics of mechanical systems. Lagrange equation of the second kind. The role of the mathematical model and calculation scheme in the analysis of robotics. Problems of kinematics and dynamics of manipulators. Vector method for kinematic analysis of manipulators. Direct and inverse problems of the provisions. Forward and reverse speed problems. Determination of generalized velocities of a manipulator that implements movement along a given trajectory with a given orientation. Analysis of accelerations of the links during movement of the manipulator. Angular acceleration of links. Linear acceleration. Dynamics of manipulators. Identification and diagnostics of robotic systems. Algorithm for optimizing the manipulator's performance. Kinetostatics method, equations of motion. Dynamic model. Identification and diagnostics of robotic systems. Lagrange equations and the D'Alembert principle in robot dynamics. The Gauss principle in robot dynamics. Algorithms for solving dynamics problems using Lagrange equations. Determination of reactions in kinematic pairs. The Gauss principle in robot dynamics. Inverse problems of dynamics. Equations of robot motion based on a differential program along a given trajectory. Optimization of robot movement.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, a master's student must:

Know and understand: the theoretical foundations of modeling used in dynamic calculations in the design of mechatronic and robotic systems; the basic principles of constructing computational schemes and mathematical models of mechatronic systems and the requirements for them; the theoretical foundations and algorithms used in solving problems of dynamic analysis of mechatronic systems. Be able to: create a design scheme, mathematical model and perform the required dynamic calculations of mechatronic systems in application software packages; apply knowledge and understanding to analyze dynamic parameters to determine the main characteristics of nodes and modules in the design of mechatronic systems. Possess (demonstrate skills and experience): skills in solving problems of modeling and dynamic analysis in visual programming systems (Simulink) with analytical and engineering methods for solving analysis problems in the design of mechatronic systems; skills in independent work on collecting, demonstrate skills in working with 5 specialized application software packages.

Design of special-purpose robotic systems
CODE-ROB238
CREDIT – 4
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

The purpose of teaching the discipline is to systematize and integrate previously acquired knowledge in the disciplines of bachelor's and master's training in the direction of "Robotics and mechatronics".

Defining and formalizing the tasks facing robotics; drawing up requirements for components of robotic systems; understanding the problems of designing high-performance mechatronic modules and systems of special-purpose objects; obtaining methodological foundations for system design of multicomponent integrated systems, taking into account the specifics of automated production, reasonable choice of the object of automation and robotization, and comprehensive consideration of technical, economic and social aspects.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of studying the discipline, a master's student must:

know:

- goals, tasks, methods and stages of designing mechatronic and robotic devices and special-purpose systems;
- a set of requirements for the control systems of machines for various technological purposes, imposed in various industries, to drives and their control systems;

be able to:

- technically and economically soundly choose the element base for the schematic implementation of the control of a special-purpose robotic system;
- define requirements and develop technical specifications for individual subsystems of robotic systems, including mechanical devices, electronic, microprocessor, Electromechanical and other devices;

possess:

- skills of an integrated approach to the design of special-purpose robotic systems;
- skills of generalization and use of experience in the field of creation and operation of control systems.

Robust systems and adaptive management
CODE-ROB218
CREDIT – 4
PREREQUISITE – no

COURSE GOALS AND OBJECTIVES

In the study of new adaptive, robust, and robust-suboptimal control systems for single-connected, multi-connected, and networked linear and nonlinear output objects that are easy to implement in terms of parametric, signal, functional, and structural uncertainties.

BRIEF DESCRIPTION OF THE COURSE

The main task is to 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.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of studying the discipline, a master's student should:

know:

- functional purposes of adaptive control methods for structurally indeterminate linear and nonlinear objects with a delay in state and control using a modified high-order adaptation algorithm.

be able to:

develop new approaches for robust and robust-suboptimal output control of parametrically, signally, functionally, and structurally indeterminate linear and nonlinear objects with or without state delay.

possess:

- skills to implement the acquired knowledge in the practical implementation of projects.

Preparation and defense of a master's thesis
CODE-ECA501
CREDIT-12

The purpose of the master's thesis is
to demonstrate the level of scientific/research qualification of the master's student, the ability to independently conduct scientific research, test the ability to solve specific scientific and practical problems, knowledge of the most General methods and techniques for solving them.
BRIEF DESCRIPTION
Master thesis – graduation qualification scientific work, which is a generalization of the results of independent studies undergraduates one of the pressing problems of a particular specialty relevant branch of science that has internal unity and reflects the progress and results of the development of the chosen topic.
Master's thesis-the result of research /experimental research work of a master's student, conducted during the entire period of study of a master's student.
Master's thesis defense is the final stage of master's degree preparation. The master's thesis must meet the following requirements:
- the work should conduct research or solve current problems in the field of robotics and mechatronics;
- the work should be based on identifying important scientific problems and solving them;
- decisions must be scientifically sound and reliable, and have internal unity;
- the dissertation work must be written individually.

Content

РЕЦЕНЗИЯ

на образовательную программу
«7М07107 Робототехника и мехатроника»

Срок обучения – 2 года.

Содержание образовательной программы магистратуры разработано на основе принципов непрерывности и преемственности с предыдущим уровнем образования - бакалавриат. Все дисциплины являются логическим продолжением дисциплин бакалавриата, их содержание носит более углубленный характер.

Образовательная программа построена таким образом, чтобы обеспечивалась целостность образования, сочетание фундаментальной подготовки с междисциплинарным характером профессиональной деятельности специалиста и полностью соответствует требованиям Типового учебного плана по специальности высшего образования.

Содержание и объем учебных курсов по базовым дисциплинам являются достаточными для последующего изучения профилирующих дисциплин.

Структура образовательной программы основана на модульном принципе, при составлении которой соблюдается комплексный подход.

Образовательная программа специальности нацелена на достижение определенного образовательного результата, от фундаментальных и общих профессиональных до специальных узко прикладных.

Виды профессиональных практик, диссертационные работы включаются в соответствующие модули образовательной программы в зависимости от взаимосвязи и единства целей с учебными дисциплинами.

Программа обеспечивает изучение и исследование всех видов современных информационно-измерительных систем и комплексов.

Программа обеспечивает магистрантам возможность проходить стажировку за рубежом и проводить различные исследовательские работы. Развивает у магистрантов способности к пониманию современных достижений в области проблем развития приборостроения.

Заместитель директора по ИиИТ ТОО «Корпорация Сайман» Корпорация Сайман **Байбеков К.И.**