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 Science of the educational program "7M07107-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 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.

Brief description of the program

1 Goals of the educational program

Purposes of EP "Robotics and mechatronics" are:

meeting the needs of students for intellectual, creative and professional development by obtaining knowledge and skills in the field of robotic and mechatronic systems;

organization of master's degree programs that allow all graduates to continue their education both with the goal of obtaining a PhD in the field of robotic and mechatronic systems, and with the goal of further self-improvement in order to successfully build a career in production;

meeting the needs of the Republic of Kazakhstan for qualified personnel by training specialists in the use and maintenance of robotic and mechatronic complexes and specialists with computer-controlled engineering skills in connection with the industrialization and digitalizationвof the industry.

2 Types of employment

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

- research organization;
- design Department;
- organizational and managerial structure;
- installation and commissioning;
- service and operational documentation;
- scientific-pedagogical.

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

research activities:

- analysis of scientific and technical information, domestic and foreign experience in the development and research of robotic and mechatronic systems; study of new methods of control theory, artificial intelligence technologies and other scientific areas that make up the theoretical base of robotics and mechatronics, preparation and publication of reviews and abstracts;

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

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

- conducting the development of experimental samples of robotic and mechatronic systems, their modules and subsystems in order to verify and substantiate the main theoretical and technical solutions to be included in the terms of reference for the performance of development work;

- organizing and conducting experiments on existing robotic and mechatronic systems, their subsystems and individual modules in order to determine their effectiveness and determine ways to improve, processing the results of experimental studies using modern information technologies;

- preparation of reports, scientific publications and reports at scientific conferences and seminars, participation in the implementation of research and development results in practice;

design and development activities:

- preparation of a feasibility study of projects for new robotic and mechatronic systems, their individual subsystems and modules;

- calculation and research of robotic and mechatronic systems, control, information-sensory and Executive subsystems using mathematical modeling methods, layout and testing of existing systems, processing of experimental data with the use of modern information technologies;

- development of special software for solving problems of designing robotic and mechatronic systems, development of technical specifications and direct participation in the design of mechanical, mechatronic and robotic modules, design of mechatronic and robotic devices, control and information processing systems;

organizational and managerial activities:

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

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

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

installation and commissioning activities:

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

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

service and maintenance activities:

- participation in the verification, adjustment, adjustment and evaluation of the state of robotic and mechatronic systems for various purposes, as well as their individual subsystems, in the setting up of control hardware and software complexes;
- preventive maintenance of technical condition and functional diagnostics of robotic and mechatronic systems for various purposes, as well as their individual subsystems;
- preparation of operating instructions for robotic and mechatronic systems and their hardware and software, development of routine testing programs;
- preparation of applications for equipment and components, preparation of technical documentation for equipment repair;

scientific and pedagogical activity:

- participation in the development of programs of academic disciplines and courses based on the study of pedagogical, scientific, technical and scientific-methodical literature, as well as the results of their own professional activities;
- participation in setting up and modernizing individual laboratory works and workshops in professional disciplines;
- conducting training sessions with students, participating in the organization and management of their practical and research work;
- application and development of new educational technologies, including computer and distance learning systems.

3 Objects of professional activity

The objects of professional activity of the graduate are:

- robotic and mechatronic systems, 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 of robotic and mechatronic systems for various purposes.

PASSPORT OF THE EDUCATIONAL PROGRAM

1 Scope and content of the program

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.

The content of the EP "Robotics and mechatronics" within the specialties 6M071600-Instrument Engineering 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 studying academic subjects and passing 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 junction 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;
- using highly professional training of undergraduates in various educational environments;
- training a new competitive generation of technical specialists for the labor market;
- developing an environment that supports people of different cultures, and creating an atmosphere of striving for knowledge, academic integration and intellectual motivation;
- conducting research and educational activities based on the world's best practices, developing their own methods and style of training specialists;
- development of cooperation "University-industry" to meet the requirements of the labor market for technical specialists, to improve the quality of educational programs for training specialists;
- development of additional educational and training programs using multimedia, new teaching technologies for organizing learning based on the principle of lifelong learning;
- establishing partnerships with other universities and organizations to improve the quality of education, to support technical and cultural ties.

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 pattern and confirm the level of English language proficiency with a certificate or diplomas of the established pattern.

The procedure for admitting citizens to the master's program 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 by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of their own funds of citizens 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", the master's student must have all the prerequisites necessary to master the relevant educational program of the master's degree. The list of necessary prerequisites is determined by the higher educational 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 training and obtaining a diploma

Degree/qualifications awarded: The graduate of this educational program is awarded the academic degree "master of technical science" in the direction.

A graduate who has completed a master's degree program must possess the following General professional competencies:

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

– ability to independently formulate research goals, establish a sequence of solving 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;

– ability to choose professionally and creatively use modern equipment for solving scientific and practical problems;

– ability to critically analyze, present, protect, 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 the team in the sphere of their professional activities, tolerant of social, ethnic, confessional and cultural differences;

– readiness to communicate in oral and written forms in a foreign language to solve the problems of professional activity.

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

research activities:

– the ability to make mathematical models of robotic and mechatronic systems, their subsystems, including Executive, information-sensory and control modules, using formal logic methods, finite automaton methods, 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;

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

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

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

– willingness to prepare analytical reviews and scientific and technical reports

based on the results of work performed, to prepare publications on the results of research and development;

– the ability to implement in practice the results of research and development carried out 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 creating robotic and mechatronic systems, their subsystems and individual modules;

– ability to prepare technical specifications for designing robotic and mechatronic systems of their subsystems and individual devices using standard Executive and control devices, automation tools, measuring and computer technology, as well as new devices and subsystems;

– the ability to participate in the development of design and project documentation of 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;

– willingness to develop technical documentation (work schedules, instructions, plans, estimates) in accordance with approved forms;

– willingness to apply methods of prevention of industrial injuries, occupational diseases, prevention of environmental violations;

installation and commissioning activities:

– ability to set up, adjust and configure 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 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 conduct preventive maintenance 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 prepare applications for equipment and components, to participate in the preparation of technical documentation for equipment repair.

scientific and pedagogical activity:

– readiness to take direct part in educational and methodological work on the profile of the training area, to participate in the development of programs of academic disciplines and courses;

– ability to conduct training sessions, laboratory work, provide practical and research work of students;

– ability to apply new educational technologies.

When developing the master's degree program, all General cultural and General professional competencies are included, as well as professional competencies related to the types of professional activities of specialists in robotics and mechatronics.

4 Working curriculum of the educational program

4.1. duration of study is 2 years

MODULAR CURRICULUM

Education program *7M07107 - Robotics and Mechatronics*

Form of study: *full* Duration of training: *2 years* *Academic degree: Master of Technical Sciences*

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	HUM201	History and philosophy of science	1	4	1	0	1	2	Exam	SD
BD 1.2.2	HUM207	Higher school pedagogy	1	4	1	0	1	2	Exam	SD
BD 1.2.3	LNG202	Foreign language (professional)	2	6	0	0	3	3	Exam	EL
BD 1.2.4	HUM204	Management psychology	2	4	1	0	1	2	Exam	SECPM
Module of robotic systems (18 credits)										
Elective disciplines										
BD 1.2.6	ROB232	Information devices and systems	1	6	2	0	1	3	Exam	RaETA
BD 1.2.6.1	ROB240	Biotechnical systems and technologies	1	6	2	0	1	3	Exam	RaETA
BD 1.2.7	ROB256	The dynamics of robots	2	6	2	0	1	3	Exam	RaETA
BD 1.2.7.1	ROB257	Biotechnical control systems	2	6	2	0	1	3	Exam	RaETA
Mandatory disciplines										
PS 1.3.1	ROB236	Multi-agent robotic systems	1	6	2	0	1	3	Exam	RaETA
Module of robotic control systems (24 credits)										
Elective disciplines										
BD 1.2.8	ROB237	Control of mobile robots in an unknown environment	2	6	2	0	1	3	Exam	RaETA
BD 1.2.8.1	ROB230	Microprocessor control systems	2	6	2	0	1	3	Exam	RaETA
PS 1.3.2	ROB225	Intelligent control technology	2	6	2	0	1	3	Exam	RaETA
PS 1.3.3	ROB233	Robot Navigation Systems	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 2.3.4	ROB259	Deep learning for robots	3	6	2	0	1	3	Exam	RaETA
PS 2.3.4.1	ROB244	Detection and filtering of biomedical signals	3	6	2	0	1	3	Exam	RaETA
Elective disciplines										
Module for designing robotic systems (18 credits)										
PS 2.3.5	ROB234	Mathematical modeling and optimization of motion of multi-tier systems	3	6	2	0	1	3	Exam	RaETA
PS 2.3.5.1	ROB242	Mathematical modeling of biological processes and systems	3	6	2	0	1	3	Exam	RaETA
PS 2.3.6	ROB238	Designing special purpose robotic systems	3	6	2	1	0	3	Exam	RaETA
PS 2.3.6.1	ROB248	Verification, safety and reliability of medical equipment	3	6	2	1	0	3	Exam	RaETA
PS 2.3.7	ROB235	Digital processing of measurement information	3	6	2	0	1	3	Exam	RaETA
PS 2.3.7.1	ROB252	Automated design of medical equipment	3	6	2	0	1	3	Exam	RaETA

Practice-oriented module (11 credits)										
BD 1.2.5	AAP244	Pedagogical practice	2	4	0	0	0	2	Report	RaETA
PS 2.3.8	AAP236	Research scientific training	4	7					Report	RaETA
Research Module (24 credits)										
MSSR	AAP242	Master's student scientific research, including an internship and a master's thesis.	1	6					Report	RaETA
MSSR	AAP242	Master's student scientific research, including an internship and a master's thesis.	2	6					Report	RaETA
MSSR	AAP242	Master's student scientific research, including an internship and a master's thesis.	3	6					Report	RaETA
MSSR	AAP242	Master's student scientific research, including an internship and a master's thesis.	4	6					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				**125**						

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

The 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 mastered competencies expressed in the achieved learning results.

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 disciplines.

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 their professional knowledge, understanding and abilities 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 inferences;

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

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

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							
HUM201	History and philosophy of science		x			x				x	x	x				x	x				x
HUM205	Pedagogy of higher education			x	x		x	x							x	x					
HUM204	Management psychology			x	x		x	x	x		x			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
ROB225	Intelligent control technology												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	Research work of a master's student									x	x		x				x	x	x	x	x
AAP244	Pedagogical practice							x							x	x					
AAP236	Research practice							x	x	x	x	x	x				x	x	x	x	x

7 Annex to the certificate according to the standard ECTS

The application is developed according to the standards of the European Commission, the Council of Europe and UNESCO/Sepes. This document serves only for academic recognition and is not an official confirmation of a document of education. It is not valid without a higher education diploma. The purpose of completing the European

application is to provide sufficient data on the holder of the diploma, the qualification they have obtained, 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 translating grades uses the European credit transfer or transfer transfer system (ECTS).

The European diploma Supplement allows you to continue your education at foreign universities, as well as confirm your 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 the courses

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

PURPOSE AND OBJECTIVES OF THE COURSE
Thanks to this course, you will master specific terminology, be able to read specialized literature, and gain the knowledge necessary to carry out effective oral and written communications in a foreign language in your professional activity.
BRIEF DESCRIPTION OF THE COURSE
In the course of training, students acquire knowledge of a foreign language, including the possession of specialized vocabulary, necessary for effective oral and written communications 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 AND ABILITIES AT THE END OF THE COURSE
As a result of mastering the discipline, the student will expand the professional lexical vocabulary, possess the skills of effective communication in a professional environment, the ability to correctly Express thoughts in oral and written speech, understand specific terminology and read specialized literature.

History and philosophy of science
CODE-HUM201
CREDIT – 4
PRECONDITION-no

THE goals AND OBJECTIVES of the COURSE are to reveal the connection between philosophy and science, highlight the philosophical problems of science and scientific knowledge, the main stages of the history of science, the leading concepts of philosophy of science, modern problems of the development of scientific and technical reality
BRIEF COURSE DESCRIPTION the subject of philosophy of science, science dynamics, the specifics of science, science and pradnya, the antiquity and the emergence of theoretical science, main stages of the historical development of science, characteristics of science, neklassicheskie and post-non-classical science, philosophy, mathematics, physics, engineering and technology, the specifics of engineering Sciences, ethics of science, social and moral responsibility of the scientist and engineer
KNOWLEDGE and SKILLS UPON completion of the COURSE - know and understand the philosophical questions of science, the main historical stages of development of science, leading to the concept of philosophy of science, to be able to critically evaluate and analyze scientific and philosophical problems, to understand the specifics of engineering science, possess the skills of analytical thinking and philosophical reflection, to be able to justify and defend its position, own techniques of discussion and dialogue, to master the skills of commutatively and creativity in their professional work.

Pedagogy of higher education
CODE-HUM205
CREDIT – 4
PRECONDITION-no

The PURPOSE AND OBJECTIVES of the COURSE the course aims to study the psychological and pedagogical essence of the educational process of higher school; the formation of ideas about the main trends of development of higher education at the present stage, the consideration of methodical bases of training process in high school, as well as the psychological mechanisms influencing the success of learning, interaction, management subjects of the educational process. Development of psychological and pedagogical thinking of undergraduates.
BRIEF description of the COURSE during the course, undergraduates are introduced to the didactics of higher education, forms and methods of organizing training in higher education, psychological factors of successful learning, features of psychological impact, mechanisms of educational influence, pedagogical technologies, characteristics of pedagogical communication, mechanisms for managing the learning process. They analyze organizational conflicts and ways of their resolution, psychological destructions and deformations of the teacher's personality.
KNOWLEDGE, SKILLS UPON completion of the COURSE – upon completion of the course the student should know the features of a modern system of higher professional education, organization of educational research, characteristics of subjects of educational process, didactic principles of organization of the learning process in higher education, educational technology, patterns of pedagogical communication, especially educational influences on students and problems of pedagogical activity.

Management psychology
CODE-HUM205
CREDIT – 4
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of the course is to study the characteristics of the behavior of individuals and groups of people within organizations; determining psychological and social factors that influence the behavior of employees. Great attention will also be paid to the issues of internal and external motivation of people

The main goal of the course is to apply this knowledge to improve the effectiveness of the organization.

BRIEF DESCRIPTION OF THE COURSE

The course is designed to provide balanced coverage of all the key elements that make up the discipline. It will briefly examine the origins and development of organizational behavior theory and practice, followed by a discussion of key management roles, skills, and functions, with an emphasis on management effectiveness, illustrated by real-life examples and case studies.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

At the end of the course, students will know: the basics of individual and group behavior; basic theories of motivation; basic theories of leadership; concepts of communication, conflict management and stress in the organization.

they will be able to identify the different roles of managers in organizations; look at organizations from the perspective of managers; and understand how effective management contributes to an effective organization.

Information devices and systems
CODE-ROB232
CREDIT – 5
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of mastering the discipline "Information devices and systems" is to study the principles of building information systems of robots, their sensitive elements, measuring circuits and amplifiers; the physical principles used in the creation of various sensors are considered, 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 quantities. Location information systems. Technical vision systems. Tactile-type systems.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

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

know:

- modern research methods;
- stages of implementation of projects in the field of robotics and mechatronics;
- basic principles of searching for scientific and technical information.

be able to:

- learn independently with the help of modern information technologies;
- use new knowledge and skills in practical activities;
- use existing software packages and, if necessary, develop new software;

own:

- the skills distribution of the work;
- skills of implementing the acquired knowledge in the practical implementation of projects;
- skills of working with modern research tools for robotic systems.

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

PURPOSE AND OBJECTIVES OF THE COURSE
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 you 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, it is necessary 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 manipulating and mobile robots. The structure and purpose of the ISON. Structure and purpose of the sensor element block (BCE). Kinematic parameters of a moving object that are measured using an 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. Output of the equation for the kinematic error of ISON.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of mastering the discipline, the student must:
know:
- principles of operation and mathematical description of the components of robot navigation systems, the essence and significance of information in the development of modern information society, satellite radio navigation systems,
be able to:
- apply theoretical knowledge in solving practical tasks of robot navigation,
- apply the necessary knowledge to build mathematical models, set goals and choose ways to achieve them, work in a team,
own:
- skills of developing robot navigation systems; ability to analyze the state of scientific and technical problems 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.

Diagnostics and reliability of technical systems and devices
CODE-ROB202
CREDIT – 5
PRECONDITION – physics, chemistry, mathematics, electronics

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of studying the discipline is to study methods for evaluating the reliability of technical systems at the design stage, to study methods for evaluating the reliability of technical systems in operation, to apply probability theory to predict and prevent equipment failures, to study methods for diagnosing existing equipment.

BRIEF DESCRIPTION OF THE COURSE

The discipline "Diagnostics and reliability of technical systems and devices" includes the following main directions. Modern scientific concepts in the development of safety assessment of technical systems. Theory of reliability of devices, machines and structures. Reliability indicators, mathematical models of reliability and survivability. Mathematical expectations of the number of failures and the application of the theory of reliability and survivability to the conditions of designing machines and structures. The theory of survivability. Damage accumulation models. Mechanics of fatigue failure. Forecasting at the design stage. Monitoring the destruction of machines and mechanisms. Maintenance planning. In accordance with the above, the teaching of the discipline "Diagnostics and reliability of technical systems and devices" aims to equip future specialists with knowledge of the main provisions of the theory of reliability and survivability of technical systems.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

After studying this discipline, мthe student must:

know and be able to:

- apply in practice the main provisions of reliability theory, evaluate the reliability of technical systems, reliability theory in any industry that relies on mathematics and technical disciplines,

present them correctly:

- technogenic risk inherent in the proposed project submitted for technical expertise and be competent in carrying out measures designed to minimize damage in the event of industrial accidents, evaluate methods of their prediction and prevention,

skills:

- assessment of reliability and technogenic risk of technical systems under construction and being modernized.

Managing mobile robots in an unknown environment
CODE-ROB237
CREDIT – 5
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to form masters ' knowledge about automatic and automated control of mobile robots, methods and methods of design, debugging and operation of mobile robots using computer-aided design and production systems, taking into account unknown, random, nondeterministic influences.
BRIEF DESCRIPTION OF THE COURSE
The discipline "Managing mobile robots in an unknown environment" studies methods and principles of design and subsequent construction of automatic control systems. Mathematical description of static and dynamic objects, development and design of mechanical and electrical components of robotic and mechatronic systems with subsequent automated control are considered.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of studying the discipline, the master's student must:
know:
description subject area technology systems, performance and the accumulation of knowledge about the technical structures of the systems in a hierarchical system of concepts of functional, schematic, circuit connections between them; know the basic principles of cell mechanisms in the unknown environment;
be able to:
- plan the robot's path; build a path graph, optimize it; process environmental images; filter and correct geometric images; solve engineering problems in the spatial interpretation of a non-deterministic environment in order to adapt the dynamic characteristics of systems;
own:
- practical skills in research and use of modern adaptive and intelligent mobile system management packages aimed at developing mobile robots and debugging their operation in an unknown environment.

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

PURPOSE AND OBJECTIVES OF THE COURSE
The discipline is aimed at preparing undergraduates to perform research and design functions related to the study and modeling of the dynamics of robotic systems and nodes of automated productionsystems .
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 of kinematic analysis of manipulators. Direct and inverse problems of the provisions. Direct and inverse velocity problems. Determination of generalized speeds 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 speed of the manipulator. Method of kinetostatics, equations of motion. Dynamic model. Identification and diagnostics of robotic systems. Lagrange's equations and d'alembert's principle in the dynamics of robots. 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. The inverse problem of dynamics. Equations of motion of robots constructed using a differential program, along a given trajectory. Motion optimization of robots.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of mastering the discipline, the master's student must:
To know and understand: theoretical foundations of modeling applied in dynamic calculations in the design of mechatronic and robotic systems; basic principles of constructing computational schemes and mathematical models of mechatronic systems and the requirements imposed on them; theoretical foundations and algorithms used in solving problems of dynamic analysis of mechatronic systems.
Be able to: make 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 of activity): skills of solving problems of modeling and dynamic analysis in visual programming systems (Simulink) with analytical and engineering methods of solving problems of analysis in the design of

mechatronic systems; skills of independent work on collecting, demonstrate skills of working with 5 specialized application software packages.

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

PURPOSE AND OBJECTIVES OF THE COURSE

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

Definition and formalization of tasks facing robotics; drawing up requirements for the components of robotic systems; understanding the problems of designing highly efficient 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 selection of automation and robotization objects and comprehensive accounting of technical, economic and social aspects.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

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

know:

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

be able to:

- it is technically and economically reasonable to choose an elementary basis for the scheme implementation of 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;

own:

- 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.

Intelligent control technologies
CODE-ROB225
CREDIT – 5
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the theoretical foundations of artificial intelligence, neural network technologies of intelligent systems, technologies for building control systems with fuzzy logic, fuzzy logic rules, technologies for creating a knowledge base, expert control systems, adaptive control systems, задач теории и техники интеллектуальных систем, etc. This knowledge is necessary for further understanding of the principles of building robotic systems.
BRIEF DESCRIPTION OF THE COURSE
This course covers the theoretical foundations of artificial intelligence, neural network technologies of intelligent systems, technologies for building control systems with fuzzy logic, fuzzy logic rules, technologies for creating knowledge base rules, expert control systems, adaptive control systems, multi-level information processing technologies, optimal control problems, problems ofthe theory and technology of intelligent systems, etc.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of studying the discipline, the master's student must
know:
-neural network technologies of intelligent systems, technologies for building systems with fuzzy logic, with a knowledge base, expert systems, adaptive systems, etc.;
be able to:
- develop control systems with fuzzy logic, using neural networks, expert control systems, adaptive control systems, etc.;
own:
- skills in developing intelligent control systems, including expert control systems, fuzzy logic systems, adaptive systems, etc.

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

PURPOSE AND OBJECTIVES OF THE COURSE
The study of multi-agent systems, which is one of the new promising directions of artificial intelligence, whichPoE formed on the basis of results of researches in oblaSTI distributed computer systems, network technologies for problem solving in parallel computing, which is the principle of the autonomy of the individual, the hourchildren program, jointly functioning in RASopredelennoi system, where at the same time takes a lot of interrelated computing processes according to the programs called by multiagents.
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 problems of artificial intelligence 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 in the form of distributed dynamic environments and intelligent agents are considered, which provide an adequate reflection of the increasing complexity of decision-making on business management in conditions of uncertainty and conflicts, eventfulness, situativeness, high connectivity with the use of multi-agent robotic systems.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of mastering the discipline, the master's student must:
know:
- General principles of building multi-agent robotic systems;
- methodology, methods and models of forming multi-agent robotic systems;
be able to:
- implement the synthesis of multi-agent robotic systems.
Own:
- methods of using multi-agent robotic systems.

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

PURPOSE AND OBJECTIVES OF THE COURSE
In the study by undergraduates of new adaptive, robust and robust -suboptimal control systems for single-connected, multi-connected and network linear and nonlinear objects at the output, 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-link, multi-link and network linear and nonlinear objects.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of studying the discipline, the master's student must:
know:
- functional assignments of adaptive control methods for structurally indeterminate linear and nonlinear objects with state and control lag using a modified high-order adaptation algorithm.
be able to:
to develop new approaches for robust and robust -suboptimal control of parametrically, signally, functionally and structurally indeterminate linear and nonlinear objects both with and without state delay.
own:
- skills of implementing the acquired knowledge in the practical implementation of projects.

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

PURPOSE AND OBJECTIVES OF THE COURSE

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 of the main elements of the SimMechanics library and the principles of forming models of spatial mechanisms and machines in the SimMechanics environment, visualization of movements of spatial mechanisms and machines using 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 relationships) using the developed special physical and mathematical apparatus SimMechanics, the Simulink system extension package for physical modeling. This technical design and simulation of mechanical systems (within the framework of the laws of theoretical mechanics) SimMechanics allows you to model translational and rotational movements 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 specifying and measuring movements.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

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

Know:

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

Be able to:

осуществлять develop new approaches to mathematical modeling and optimization of motion of multi-link mechatronics systems .

Own:

- skills of implementing the acquired knowledge in the practical implementation of projects.

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

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the discipline is to study the role and value of digital signal processing in receiving and transmitting information, the features and advantages of digital signal representation, the study of digital transformation algorithms, the implementation of digital processing in telecommunications, information and measurement 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 scope of digital signals and digital signal processing (DSP) systems. Kotelnikov's Theorem.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of mastering the discipline, the master's student must:
know:
– advantages of digital signals and their role in the creation of robotic and mechatronic systems and complexes;
– mathematical apparatus for describing digital signals and systems;
– various methods and algorithms of digital filtering;
– a modern element base for implementing digital signal processing systems.
be able to:
– mathematically describe digital signals and their processing systems;
– use software applications for implementing digital signal processing systems.
own:
– mathematical and algorithmic methods of 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.

Information topologies and networks
CODE-ROB250
CREDIT – 4
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of mastering the discipline is to provide undergraduates with theoretical knowledge and practical skills to solve the following professional tasks:
development of special software for solving problems of mechatronic and robotic systems design, development of technical specifications and direct participation in the design of mechanical and mechatronic modules, design of devices and systems for control and information processing;
The objectives of the discipline are:
- obtaining systematic knowledge of information topologies and networks in computer control systems of robotic systems by undergraduates;
- mastering the skills of designing and practical implementation of various automated control systems for robotic systems**.**
BRIEF DESCRIPTION OF THE COURSE
Tools for automation systems and control of technological objects. PROCESS CONTROL SYSTEM. Hierarchical structure of the administrative division. Communication environment and data transfer to the automated control system. Purpose and classification of computer networks. Characteristics of the data transfer process. Hardware implementation of data transfer. Reference models of system interaction. OSI model. Computer network protocols. Local area network.
KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of mastering the discipline, the master's student must:
know:
- basic principles of designing industrial networks of automation and object management systems;
be able to:
- develop technical specifications for designing industrial networks of robotic systems;
- to set up, adjust and configure the network equipment of mechatronic and robotic systems;
own:
- skills and methods of designing industrial networks;
- debugging skills of software and hardware complexes.

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

The purpose of the master's thesis is:
demonstration of the level of scientific/research qualification of a master's student, the ability to independently conduct scientific research, checking the ability to solve specific scientific and practical problems, knowledge of the most General methods and techniques for solving them.
BRIEF DESCRIPTION
Master's thesis – a final qualifying scientific work that is a generalization of the results of independent research by an undergraduate of one of the actual problems of a particular specialty in the corresponding branch of science, which has an 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 the master's student, conducted during the entire period of study of the master's student.
The defense of a master's thesis is the final stage of master's training. A master's thesis must meet the following requirements:
- the work should involve research or solve current problems in the field of robotics and mechatronics;
- the work should be based on the identification of important scientific problems and their solution;
- decisions must be scientifically based and reliable, 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.**