NJSC «Kazakh National Research Technical University named after K.Satpayev»
Institute of Industrial Automation and Digitalization
Automation and Control Department

EDUCATIONAL PROGRAM

«AUTOMATION AND ROBOTIZATION»
(Scientific and pedagogical direction (2 years)

Master of Technical Sciencesin Educational program «7M07101Automation and robotization»

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

Almaty 2021

The program is compiled and signed by the parties:

from KazNITU named after K.I. Satpayev:

1. Head of the Department of Automation and Control (AaC), Candidate phys.-math. Sciences — N.U. Aldiyarov

2. Director of Institute of Industrial Automation and Digitalization (IIAD), PhD — B.O. Omarbekov

3. Chairman of the educational-methodical group of the Department of AaC, Doctor of Technical Sciences, Professor — B.A. Suleimenov

From employers

Deputy Director Saiman Corporation LLP — K.I. Baybekov

Approved at the meeting of the Academic Council of the Kazakh National Research Technical University named after K.I. Satpayev, (protocol No.3 th June 25, 2021)

Qualification:

Level 7 of the National Qualifications Framework:
7M071 Engineering (master).

Professional competencies: Automation, robotization, artificial intelligence and digitalization of production.

Brief description of the program:

1. Goal

The purpose of the educational program is to train undergraduates in basic and specialized disciplines with the achievement of relevant competencies.

2. Typeof employment

Master of Technical Sciences in the automation of production processes must have competence in accordance with the types of professional activities:

in the field of industrial and technological activities:

- to be a leading engineer, a leading specialist of the production division for the operation, maintenance, repair and adjustment of technical means of automated production process control systems in various industries; *in the field of organizational and control activities:*
- to be the head of the division for the maintenance and repair of components and devices of automated control systems for production processes in various industries; *in the field of experimental research:*
- to be a leading expert in conducting experimental studies of industrial production automation; *in the field of research and teaching activities:*
- to be a researcher at a research laboratory for research and development of modern automated control systems for production processes in various industries;
- to be a bachelor teacher on special disciplines in the field of production processes automation; *in the field of design activity:*
- to be a leading engineer or chief engineer of a project for the development and design of automated control systems for production processes in various industries.

Master of Technical Sciences in the field of robotization of production processes must have competence in accordance with the types of professional activity:

in the field of industrial and technological activities:

- to be a leading engineer, a leading specialist of the production division for the maintenance, repair and adjustment of technical means of robotic systems in various industries; *in the field of organizational and control activities:*
- to be the head of the division for the operation and repair of elements and devices of robotic technological complexes in various industries; *in the field of experimental research:*
- to be a leading expert in conducting experimental studies of objects of robotization of industrial production; *in the field of research and teaching activities:*

- to be a researcher at a research laboratory for research and development of modern robotic systems in various industries;
- to be a college or bachelor teacher on special disciplines in the field of robotization of production processes; *in the field of design activity:*
- to be a leading engineer or chief engineer of a project for the development and design of robotic systems in various industries.

3 Objects of professional activity:
- automation and process control systems;
- robotic systems and complexes;
- training of college students and undergraduate on specialty disciplines.

During the educational process there are provided production practices at such enterprises as: “Verbulak” LLP, “Siemens-Kazakhstan” LLP, “ASUTP-Honeywell” LLP, “NAT Kazakhstan” JSC, “Kazatomprom” JSC, “Kazzinc” LLP, “Kazphosphate MU” LLP, “Karachaganak Petroleum Operating".

Scientific internships are also foreseen in: Lublin Technical University (Poland), St. Petersburg State Technical University (Russia).

EDUCATIONALPROGRAMPASSPORT

1. Volume and content of the program

The term of study for the master degree is determined by the volume of academic credits. The master's educational program is considered fully mastered after learning a set amount of academic credits and achieving the expected learning outcomes for a master's degree. In the scientific and pedagogical master degree at least 120 academic credits for the entire period of study, including all types of educational and scientific activities of the undergraduate.

Planning the content of education, the method of organizing and conducting the educational process is carried out by the university and the scientific organization independently based on the credit technology of training.

Master's degree in scientific and pedagogical direction implements educational programs of postgraduate education in the preparation of scientific and scientific-pedagogical staff for universities and scientific organizations with indepth scientific, pedagogical and research training.

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

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

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

3) research work, including the implementation of the master's thesis - for scientific and pedagogical master degree; 4) final certification.

Professional activities of graduates of the program covers the field of automation, robotization, artificial intelligence and automated control.

The program direction of specialty and specializations relates to engineering. Professional activities of graduates of the program are aimed at automation, robotization, artificial intelligence and automated control.

The direction of the program of specialty and specialization covers engineering.

Objectives of the educational program:

On the basis of the achievements of modern science, technology and production, to give knowledge and skills in the field of:

- automation;
- robotization;
- artificial intelligence;
- automated control.

The purpose of the educational program is to teach master student basic and core disciplines with the achievement of relevant competencies

In case of successful completion of the full magistracy course the graduate is awarded with the academic degree of "Master of Technical Sciences in the field of automation and robotization".

The magistracy educational program “Automation and Robotization” differs from the existing educational program on the specialty 6D070200 - “Automation and Control” by a complete update of the internal content of the disciplines. It provides the training of master students on two trajectories (specializations): "Automated systems control" and "Robotic systems control". This is connected to the need to deepen knowledge and skills in these two “narrow” areas. The bachelor educational program at the “Automatization and Robotization” provides obtaining competences in a wider field: automation, robotization, artificial intelligence and automated control in order to ensure the adaptation of bachelor students to the requirements of the labor market. In the magistracy EP there is provided a further deepening of the acquired in the baccalaureate competencies. In this connection, the program introduced modern innovative disciplines for each of the trajectories.

Along the trajectory: "Automation of production processes" the program provides the study of the following innovative disciplines:

- modern control theory;
- data mining methods;
- digital control systems;
- microprocessor control systems;
- optimal control systems (with elements of AI);
- distributed control systems;
- automation of control systems design;
- automated systems for technological preparation of production; - MES - systems.

During the process of mastering the educational program, the Master of Technical Sciences in the field of automation of production processes should acquire the following key competencies.

Master must:

have an idea:

- about modern control systems, including digital, adaptive, optimal, microprocessor, intellectual;
- about modern methods and software means for research and design of automation systems of technological processes;

- about modern technical means: sensors (including intellectual ones), actuators, (including tracking drives), microcontrollers, microprocessors, etc., used in the automation of production processes; *know:*

- methods of automated control systems synthesis of technological and production processes in various industries;

- current trends in the development of hardware and automation systems of production processes;

- standards, methodological and regulatory materials accompanying the operation, installation, adjustment and design of automated production process control systems; *to be able to:*

- develop and to investigate with the use of modern software products mathematical models and systems for production processes automation;

- develop algorithmic and software support for microprocessor systems for production processes automation; *have skills in:*

- the organization of work on the development, installation, adjustment and operation of tools and systems for production processes automation;

- the organization of works on the collection, storage and processing of information used in the field of professional activity.

The Master of Technical Sciences in the field of automation of production processes should solve the following tasks in accordance with the types of professional activity:

in the field of industrial and technological activities:

- to be a leading engineer, a leading specialist of the production division for the operation, maintenance, repair and adjustment of technical means of automated production process control systems in various industries; *in*

the field of organizational and control activities:

- to be the head of the division for the maintenance and repair of components and devices of automated control systems for production processes in various industries; *in the field of experimental research:*

- to be a leading expert in conducting experimental studies of industrial production automation; *in the field of research and teaching activities:*

- to be a researcher at a research laboratory for research and development of modern automated control systems for production processes in various industries;

- to be a bachelor teacher on special disciplines in the field of production processes automation;

in the field of design activity:

- to be a leading engineer or chief engineer of a project for the development and design of automated control systems for production processes in various industries.

During the educational process there are provided production practices at such enterprises as: "Verbulak" LLP, "Siemens-Kazakhstan" LLP, "ASUTPHoneywell" LLP, "NAT Kazakhstan" JSC, "Kazatomprom" JSC, "Kazzinc" LLP, "Kazphosphate MU" LLP, "Karachaganak Petroleum Operating".

Scientific internships are also foreseen in: Lublin Technical University (Poland), St. Petersburg State Technical University (Russia).

In EP "Automation and robotization", at choosing the trajectory "Robotization of production processes", the following innovative disciplines will be studied:

- modern control theory;
- intellectual technologies in robotics;
- digital control systems;
- systems for numerical control of robots;
- automation of the robotic systems design;
- automated systems for technological preparation of production; - management of executive systems of robots.

During the process of mastering the educational program, the Master of Technical Sciences in the field of robotization of production processes should acquire the following key competencies.

Master must:*have*

an idea:

- about modern control systems of robots, including digital, adaptive, optimal, microprocessor, intellectual;
- about modern methods and software means for research and design of robotization systems of production processes;
- about modern technical means: sensors (including intelligent ones), actuators, (including tracking drives), microcontrollers, microprocessors, etc., used in the robotization of production processes; *know:*
- methods of the creation of robotic systems in various industries;
- current trends in the development of technical means and systems of robotization of production processes;
- standards, methodological and regulatory materials accompanying the operation, installation, adjustment and design of robotic technological systems in various industries; *to be able to:*
- develop and investigate using modern software products mathematical models of robotization systems for production processes;

- develop algorithmic and software support for microprocessor-based robotization systems; *have skills in:*

- the organization of works on the development, adjustment, installation and operation of tools and systems of robotization of production processes;

- the organization of works on the collection, storage and processing of information used in the field of professional activity.

The Master of Technical Sciences in the field of robotization of production processes should solve the following tasks in accordance with the types of professional activity:

in the field of industrial and technological activities:

- to be a leading engineer, a leading specialist of the production division for the maintenance, repair and adjustment of technical means of robotic systems in various industries; *in the field of organizational and control activities:*

- to be the head of the division for the operation and repair of elements and devices of robotic technological complexes in various industries; *in the field of experimental research:*

- to be a leading expert in conducting experimental studies of objects of robotization of industrial production; *in the field of research and teaching activities:*

- to be a researcher at a research laboratory for research and development of modern robotic systems in various industries;

- to be a college or bachelor teacher on special disciplines in the field of robotization of production processes; *in the field of design activity:*

- to be a leading engineer or chief engineer of a project for the development and design of robotic systems in various industries.

During the educational process there are provided production practices at such enterprises as: “Verbulak” LLP, “Siemens-Kazakhstan” LLP, “ASUTPHoneywell” LLP, “NAT Kazakhstan” JSC, “Kazatomprom” JSC, “Kazzinc” LLP, “Kazphosphate MU” LLP, “Karachaganak Petroleum Operating".

Scientific internships are also foreseen in: Lublin Technical University (Poland), St. Petersburg State Technical University (Russia).

2 Entry Requirements

Prior education level of applicants - higher professional education (bachelor degree). The applicant must have a diploma of a fixed pattern and confirm the level of English knowledge with a certificate or diplomas of a fixed pattern.

The procedure for citizens admission to the master degree is established in accordance with the “Model rules for admission on study in educational organizations that implement educational programs of postgraduate education”.

The formation of a undergraduates contingent is carried out through the placement of the state educational order for the training of scientific and pedagogical staff, as well as tuition fees at their own expense and other sources.

Citizens of the Kazakhstan Republic are granted the right to receive free post-graduate education on a competitive basis, in accordance with the state educational order, if they receive education at this level for the first time.

At the "entrance" the undergraduate student should have all the prerequisites necessary for learning the corresponding educational program of the master degree. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a fee basis.

Admission to the university is carried out according to the applications of the applicant, who completed the full course of baccalaureate program "Automation and robotization" in accordance with the points of the certificate issued on the results of testing at the Republican Testing Center on: English, theoretical fundamentals of electrical engineering, linear automatic control systems.

Special requirements for admission to the program are applied to graduates of related educational programs: instrumentation, information systems, computers and software, radio engineering, electronics and telecommunications, information security systems, electric power industry.

3 Requirements to complete the course and receive a diploma

Awarded degree / qualifications: The graduate of this educational program is assigned an academic degree "Master" of Technical Sciences in the field of automation, robotics, artificial intelligence and digitalization of production.

The leaning outcomes of the Master's program “Automation and Robotics” based on framework standards and the guidelines of the **EUR-ACE** European Network for Quality Assurance in Engineering Education (**ENAEE**) are given below.

3.1 Knowledge and understanding

In the process of training, students in accordance with the requirements of the **EUR-ACE**of program "Magistracy" must demonstrate:

• *deep knowledge and understanding of mathematics and other basic sciences, which are the basis of their engineering specialization, at the level necessary to achieve other learning outcomes of the program.*

Master candidates study natural sciences and mathematics (NSM) while studying in baccalaureate. The NSM block of baccalaureate includes the following disciplines: Introduction to Physics, Physics I, Physics II, Algebra and Introduction to Mathematical Analysis, Mathematics I, Mathematics II, Mathematics III, Complex Variable Function Theory, Ordinary Differential Equations, Partial Differential Equations, Mathematical Foundations management theory. Bachelor's knowledge and skills in ENM with a total volume of 54 ECTS credits provide mastering of special disciplines in the magistracy.

• *deep knowledge and understanding of engineering disciplines, which are the basis of their specialization, at the level necessary to achieve other learning outcomes.*

The bachelor degree curriculum program “Automation and Robotization” provides for the mastering the following general engineering disciplines: “Theoretical Foundations of Electrical Engineering”, “Electronic Automation Devices”, “Microelectronics”, “Python Programming”, “Object-Oriented Programming”, “Technological Measurements and Instruments” , "Actuators of automation systems"

In the magistracy students study the following disciplines: Diagnostics of elements of automation systems, Reliability of the control system and its elements, Organization of research and experimental design works, “Operational management of production processes”, “Modern information technologies”.

General engineering disciplines are the basis for mastering specialized disciplines in the specialization: “Automation of production processes” or “Robotization of production processes”.

- *awareness of advanced knowledge in the areas of professional activity*.

All specialized disciplines of master and bachelor educational programs “Automation and Robotization” include (in addition to the classical foundations) the modern achievements of science and production in the field of automation and robotics.

• *awareness in a wide interdisciplinary context of engineering and knowledge of problems in various fields of engineering.*

All general engineering disciplines of the baccalaureate and master's degree of “Automation and Robotization” education program are interconnected with each other through a system of prerequisites and postrequisites.

Mastering these general engineering disciplines allows undergraduates to successfully master specialized disciplines in an interdisciplinary context.

3.2 Engineering analysis

In accordance with the **EUR-ACE** framework standards, in the process of study, students in the Magistracy program must demonstrate:

• *the ability to analyze new integrated engineering products, processes and systems in broad interdisciplinary contexts; choose and apply the most appropriate methods from the appropriate analytical, computational and experimental or new innovative methods; interpret in detail the results of such analyzes.*

A significant volume (54 ECTS credits) of the studied natural sciences and mathematics according to undergraduate program allows students in bachelor's and master's degrees to successfully master professional knowledge and skills.

The specialized disciplines in both undergraduate and graduate programs are closely related to knowledge of physical and chemical laws (for example, such undergraduate disciplines as “Theoretical Foundations of Electrical Engineering”, “Electronic Automation Devices”, “Microelectronics”, “Technological Measurements and Instruments” , "Actuators of automation systems" or with the following graduate disciplines: “Diagnostics of elements of automation systems”, “Reliability of the control system and its elements”, “Organization of research and experimental design works”, “Operational management of production processes”, “Modern information technologies” and others).

A very volume block of mathematical disciplines (42 ECTS credits) allows undergraduate and graduate students to successfully master such mathematical disciplines as: Optimization methods, Mathematical modeling of automation objects, Intelligent process control systems, Linear and nonlinear systems of automatic regulation, etc. – during undergraduate study as well as such mathematical disciplines of the magistracy as: Modern control theory, Automation of technical systems, Data mining methods, Intelligent technologies in robotics, Optimal control

systems, Digital control systems, Robot control dynamics, Distributed control systems, etc.

All this helps mater candidates to analyze new complex engineering products in wide interdisciplinary contexts to choose and put into practice the most suitable methods: analytical, computational, experimental or artificial intelligence methods.

• *ability to conceptualize engineering products, processes, and systems.*

Mater candidates receive these competencies when they achieve the following key learning outcomes: LO08, LO09, LO11 and LO12 (see point 3.9).

• *the ability to identify, formulate and solve unknown complex problems that have indefinite complex specificities possible from outside the field of education and non-technical nature: social, health and safety, environmental, economic and industrial.*

Bachelor degree students study the discipline "Introduction to the specialty and engineering ethics", which gives the basic concepts of engineering ethics: the history of ethics, applied ethics, professional ethics, teamwork, environmental ethics, etc. Master candidates use elements of a systematic approach when writing a dissertation and mastering the disciplines: “History and Philosophy of Science”, “Pedagogy of Higher Education”, “Management Psychology”

• *to choose and apply the most appropriate methods from the analytical, computational and experimental or new innovative methods for solving problems.*

Mastering the bachelor's disciplines: “Linear automatic control systems”, “Non-linear automatic control systems”, “Mathematical modeling of automation objects”, “Intelligent process control systems” and master's programs: “Modern control theory”, “Automation of technical systems”, “Methods of intellectual data analysis ”,“ Intelligent technologies in robotics ”,“ Optimal control systems ”, “Digital control systems”, “Dynamics of robot control”, “Research work of a master candidate” allows graduates to choose and put into practice both traditional classical methods and new innovative methods, for example, artificial intelligence methods.

• *the ability to identify, formulate and solve complex problems in new and reviving areas of their specialization.*

Mastering disciplines that are integrated, completing bachelor degree studies (“Automation of typical technological processes and production”, “Designing automation and robotization systems”, “Intelligent process control systems”, “Assembling and setting up of automation systems”) and master's degree (“ Optimal control systems ”,“ Digital control systems ”,“ Automation of design of control systems ”,“ Computer-aided design of robotic systems ”,“ Microprocessor s process control system "," Numerical robot control systems"and “Research work of a master candidate” allows graduates to identify, formulate and solve complex problems in the field of automation or robotics.

3.3 Engineering Design

The **EUR-ACE** leadership provides for students in the “Magistracy” program must demonstrate:

• *the ability to develop and design new and complex products (devices, artifacts, etc.), processes and systems with specifics that are not fully defined, requiring integrated knowledge from various fields, including: awareness of non-technical factors - social, health and safety, environmental, economic and industrial; choose and apply appropriate design methodologies or use creative thinking to develop new original design methods.*

Mastering the learning outcomes: LO1, LO2, LO8, LO9, LO10 and LO12 (point 3.9) will allow graduates of the EP “Automation and Robotization” and master candidates to develop and design new complex processes and systems with specifications that are not fully defined, requiring integrated knowledge and relevant design methodologies in the field of automation and robotization.

• *the ability to design using advanced engineering knowledge and skills*

In the bachelor's degree program, students master engineering design in the course of studying such disciplines as: “Technology of robotic production”, “Technological objects of automation”, “Technological measurements and devices”, “Executive automation devices”, “Programming of controllers and microcontrollers”, “Design of automation systems and robots ”,“ Automation of typical technological processes ”,“ Robotization of production processes ”,“ “Assembling and setting up of automation systems”, “Assembling and setting up of electrical devices” as well as the preparation and writing of the degree project or work.

Using the knowledge and skills acquired in the bachelor degree in engineering design, the master candidates consolidate them in the study of such disciplines as: “MES-systems”, “Operational Management of Production Processes”, “Microprocessor-based Process Control Systems” "," Systems of numerical software control of robots "," Automation of design of control systems "," Automation of design of robotic systems "," Management of executive systems and robots, " “Research work of a master candidate”," Research practice" according to the master degree educational program.

3.4 Research

In accordance with the **EUR-ACE** requirement, students of «Magistracy» program should demonstrate:

• *ability to identify, define and receive the necessary information.*

The master candidate acquires these skills during the development of theoretical training and, especially, during working on the dissertation.

• *the ability to find literature, consult, use scientific databases and other sources of information, carry out modeling and analysis to study complex technical issues in details*.

The master candidate acquires these skills during the performance of RWMC, during research practice and during the writing of the dissertation.

3.5 Engineering practice

In accordance with the **EUR-ACE** requirement, students of "Magistracy" program should demonstrate:

• *a wide understanding of the applied techniques and methods of analysis, design, research and shortcomings in their field of study.*

Master candidate acquire these competencies upon reaching the following learning outcomes: LO4, LO5, LO6, LO8, LO10 and LO12 (point 3.8).

• *practical skills, including the use of computer technology to solve complex problems, to create complex engineering structures and conduct comprehensive research in their field of study.*

The connection between the educational process and production begins immediately after entering the magistracy - when choosing the topic of the dissertation. All topics of dissertations by undergraduates of this CP are related to the development of control systems or robot systems for a specific industrial facility.

Having received the topic of the dissertation, the master candidate from the first semester begins to study the theory, practice and features of a particular industrial object from literary sources. In addition, the relationship between the educational process and production is carried out through the development of disciplines in which various production facilities are considered as examples: "MES-systems", "Operational Management of Production Processes", "Microprocessor-based Process Control Systems" "," Systems of numerical software control of robots "," Automation of design of control systems "," Automation of design of robotic systems "," Management of executive systems and robots, "

However, the connection between the educational process and production is most fully manifested during the passage of Research Practice with a field trip and during the conduct of the Research work of a master student and writing a master's thesis.

• *a broad understanding of the materials, equipment and tools used, engineering technology and processes, and the shortcomings in their field of study.*

Master candidate acquire these competencies upon reaching the following learning outcomes: LO5, LO6, LO9, LO10, LO11 (p. 3.9).

• *ability to apply engineering standards in their field of study.*

Master candidate in the course of "Research work of a master candidate", passing Research practice and in the process of working on a dissertation get the

opportunity to apply the norms of engineering practice in the field of automation or robotization.

• *knowledge and understanding of non-technical areas: society, health and safety, the environment and industry; having influence in engineering practice*.

Master candidate acquire these competencies upon reaching the following learning outcomes: LO1, LO2 и LO12 (p.3.9).

• *to be aware of economic, organizational and managerial matters (such as "project management", "risk management and change management") in an industrial and business context*

The study of the disciplines: "Introduction to the specialty and engineering ethics", "Management Psychology", "Pedagogy", "Management", where the basic provisions on economic, organizational and managerial issues, is provided.

3.6 Decision-making

The European Network for the Quality of Engineering Education requires that students in the “Magistracy” program must demonstrate:

• *the ability to integrate knowledge and cope with complex tasks in the field of activity, to make decisions based on incomplete or limited information, which reflect the relevant social and ethical responsibilities associated with the application of their knowledge and opinions.*

In progress towards achieving the learning outcomes: LO1, LO2, LO10, LO11 and LO12, master students gain competencies that allow them to make decisions based on incomplete or limited information in the field of automation and robotics.

• *the ability to manage complex technical or professional issues, or projects that require new strategic approaches, with taking responsibility for decision-making***.**

The master candidate gains competencies during the performance of RWMC (research work of master candidate), during research practice and during the working on the dissertation.

3.7 Communication and teamwork

In the process of study, students in the «Magistracy» program must demonstrate:

• *the ability to use a variety of methods to form clear and unambiguous conclusions and rationally substantiate them for special and non-special audiences at national and international levels.*

Master candidates acquire these competencies in progress towards obtaining the following learning outcomes: LO1, LO2, LO11, LO12, as well as when writing and defending a dissertation.

• *the ability to work effectively at the national and international level, as a member and leader of a team consisting of different professionals and levels; the ability to use broad communication skills.*

During studying in the master's program, students acquire teamwork skills, also when passing research practice and performing RWMC.

3.8 Continuing education

In the process of training according to European standards, students in the «Magistracy» program should demonstrate:

• *the ability to constantly improve qualifications in professional life*.

During working on a dissertation, master students improve their qualifications through additional study of issues related to specific scientific topics in the field of automation or robotics.

• *the ability to continue learning independently*.

Master students in the process of theoretical training according to EP "Automation and Robotization" and during performing RWMC also receive self-study skills in the field of automation and robotics.

3.9 Learning outcomes of the curriculum program "Automation and Robotization"

Graduate must be able to

LO1 To speak fluently the state, Russian and one of the common foreign languages and use them in professional activities. Be prepared for intellectual, cultural, physical and spiritual self-development to improve their skills during all professional life.

LO2 To have basic knowledge of legal and ethical standards, as well as linguistic, social and economic knowledge, ways and methods of organizing production and compliance with safety rules, labor protection and the environment.

LO3 Demonstrate knowledge of sections of higher mathematics, physics, electronics, electrical engineering and other natural sciences and apply them to solve engineering problems in the field of automation and control.

LO4 To possess modern computer, information, communication technologies and software used in the creation and operation of automation systems.

LO5 To select of measuring instruments and automation equipment, measure technological parameters, configure and operate automation elements and devices.

LO6 To possess programming skills using high-level languages, microcontroller programming tools and languages, process control simulation and research automation systems

LO7 To put into practice the knowledge of the main types of linear and nonlinear automatic control systems, their mathematical description and modeling. Perform calculations of the analysis and synthesis of regulatory systems.

LO8 To possess methods of information processing and synthesis of automation systems, methods of designing and programming data management systems. Use in practice the functionality of Scada-systems.

LO9 To design structural, functional and other automation schemes, analyze reference and normative literature, draw up technical documentation. To develop hardware, software, mathematical, algorithmic, informational and other support for automated process control systems.

LO10 To use the technical capabilities of microprocessor technology, means of reception and transmission information and software to solve automation problems.

LO11 To analyze and evaluate the state of automation facilities, technological processes and industries. Make qualified decisions on the use of elements and automation systems, their installation, setting up and operation.

LO12 To possess knowledge, skills and abilities to apply system implementation to the development of automation systems and robotization of production processes

4 The curriculum of the educational program

4.1 Duration 2 years

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
Non-profit Joint Stock Company "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATPAYEV"

SATBAYEV UNIVERSITY

Agreed by:
Board of the Non-profit Joint Stock Company
"KazNRTU named after K.I.Satpayev"
M.M. Begentayev
"28" 06 2021

WORKING CURRICULUM for 2021-2022 academic year admission

Educational program 7M07101 - "Automation and Robotization"

Group of Educational programs M100 - Automation and management

Form of study: full-time Term of study: 2 years Academic degree: Magist

year of study	Code	Name of course	Component	Academic credits	Total hours	classroom volume of lc/lab/pr	MSI (including MS(I)W), in hours	Prerequisites	Code	Name of course	Component	Academic credits	Total hours	classroom volume of lc/lab/pr	MSI (including MS(I)W), in hours	Prerequisites
	1 semester								2 semester							
1	LNG210	English language (professional)	BD UC	5	150	0/0/3	105		AAP244	Teaching practice	BD UC	4				
	HUM208	Psychology of management	BD UC	3	90	1/0/1	60		HUM210	History and philosophy of science	BD UC	4	120	1/0/1	90	
	1203	Component of choice	BD CC	5	150	2/0/1	105		HUM209	Higher School Pedagogy	BD UC	4	120	1/0/1	90	
	1202	Component of choice	BD CC	5	150	2/0/1	105		1203	Component of choice	BD CC	5	150	2/0/1	105	
	AUT708	Automation of technical systems	PD UC	5	150	2/0/1	105		1302	Component of choice	PD CC	5	150	2/0/1	105	
	1301	Component of choice	PD CC	5	150	2/0/1	105		1303	Component of choice	PD CC	5	150	2/0/1	105	
	AAP242	Scientific research work of master's	MSSR	6					AAP242	Scientific research work of master's	MSSR	6				
		In total		34						In total		33				
	3 semester								4 semester							
2	2304	Component of choice	PD CC	5	150	2/0/1	105		AAP236	Research practice	PD CC	7				
	2305	Component of choice	PD CC	5	150	2/0/1	105		ECA205	Registration and protection of the master thesis	FA	12				
	2306	Component of choice	PD CC	5	150	2/0/1	105									
	2307	Component of choice	PD CC	5	150	2/0/1	105									
	2308	Component of choice	PD CC	5	150	2/0/1	105									
	AAP242	Scientific research work of master's	MSSR	6					AAP242	Scientific research work of master's	MSSR	6				
		In total		31						In total		25				

Decision of the Academic Council KazNRTU named after K.I.Satpayev. Protocol № 3 "25" 06 2021.

Decision of the Academic Council of the Institute IARD Protocol № 12 "07" 06 2021.

Vice-rector for academic affairs B.A. Zhautikov

Institute Director

Head of Department "Automation and Control" N.U. Aldiyarov

Representative of Specialty council S.K. Abdigaliyev

Number of credits for the whole period of study	
Cycles of disciplines	**Credits**
Cycle of general education disciplines	0
A cycle of basic disciplines (BD IC, BD OC)	35
A cycle of principal subjects (PS IC, PS OC)	52
All on the theoretical classes:	87
MSSR	24
Registration and defense of the master's thesis (RaDMT)	12
In total	123

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

APPROVED
Director of the Institute of Industrial Automation and Digitalization
B.O. Omarbekov
"03" 06 2021 y.

CATALOG OF DISCIPLINES ON SELECTED MASTER'S SCHOOL for enrollment 2021-2022 academic year
Educational program 7M07101 - "Automation and robotization"
Group of educational programs M100 - Automation and control

Study period: 2 years

Optional Components - 60 Credits						
Elective code	discipline code	Name of disciplines	Cycle	ESTS	lec/lab/pr/ SRS	semester
1201	AUT703	Modern control theory	Б	5	2/0/1/3	1
	AUT297	Integrated automation technology and management			2/0/1/3	
1202	AUT266	Data Mining Methods	Б	5	2/0/1/3	1
	AUT267	Intelligent technology in robotics			2/0/1/3	
1301	AUT709	New information technologies	П	5	2/0/1/3	1
	AUT285	Modern executive devices of automation systems			1/1/1/3	
1203	AUT264	MES systems	Б	5	2/0/1/3	2
	AUT217	Optimal control automation objects			2/0/1/3	
1302	AUT299	Diagnostics of system automation	П	5	2/0/1/3	2
	AUT700	The reliability of the management system and its elements			2/0/1/3	
1303	AUT271	Microprocessor control systems of technological processes	П	5	1/1/1/3	2
	AUT272	Systems for numerical programmable control of robots			1/1/1/3	
2304	AUT705	Optimal control systems	П	5	2/0/1/3	3
	AUT706	Technical Vision system			2/0/1/3	
2305	AUT237	Digital control systems	П	5	2/0/1/3	3
	AUT251	Dynamics of robot control			1/1/1/3	
2306	AUT701	Automation of control systems design	П	5	2/0/1/3	3
	AUT702	Automated projection of robotic systems			2/0/1/3	
2307	AUT225	Automation systems design	П	5	2/0/1/3	3
	AUT707	Distributed Control Systems			2/0/1/3	
2308	AUT228	Robotic technological complexes in discrete productions	П	5	2/0/1/3	3
	AUT231	Modern local automation and control systems			1/1/1/3	

Decision of the Academic Council of the Institute of Industrial Automation and Digitalization. Minutes № 12, dated "03" 06 2021.

Director of the Institute of Industrial Automation and Digitalization — N.U. Aldiyarov

Head of the Department of Automation and Control — S.K. Abdigaliyev

year of study	Code	Name of course	Component	Academic credits	Total hours	classroom volume of lc/lab/pr	MSI (including MSIW), in hours	Prerequisites	Code	Name of course	Component	Academic credits	Total hours	classroom volume of lc/lab/pr	MSI (including MSIW), in hours	Prerequisites
1	1 semester								2 semester							
	LNG210	English language (professional)	BD UC	5	150	0/0/3	105		AAP244	Teaching practice	BD UC	4				
	HUM208	Psychology of management	BD UC	3	90	1/0/1	60		HUM210	History and philosophy of science	BD UC	4	120	1/0/1	90	
	1201	Component of choice	BD CC	5	150	2/0/1	105		HUM209	Higher School Pedagogy	BD UC	4	120	1/0/1	90	
	1202	Component of choice	BD CC	5	150	2/0/1	105		1203	Component of choice	BD CC	5	150	2/0/1	105	
	AUT708	Automation of technical systems	PD UC	5	150	2/0/1	105		1302	Component of choice	PD CC	5	150	2/0/1	105	
	1301	Component of choice	PD CC	5	150	2/0/1	105		1303	Component of choice	PD CC	5	150	2/0/1	105	
	AAP242	Scientific research work of master's	MSSR	6					AAP242	Scientific research work of master's	MSSR	6				
		In total		**34**						**In total**		**33**				

	3 semester								4 semester							
2	2304	Component of choice	PD CC	5	150	2/0/1	105		AAP236	Research practice	PD CC	7				
	2305	Component of choice	PD CC	5	150	2/0/1	105		ECA205	Registration and protection of the master thesis	FA	12				
	2306	Component of choice	PD CC	5	150	2/0/1	105									
	2307	Component of choice	PD CC	5	150	2/0/1	105									
	2308	Component of choice	PD CC	5	150	2/0/1	105									
	AAP242	Scientific research work of master's	MSSR	6					AAP242	Scientific research work of master's	MSSR	6				
		In total		**31**						**In total**		**25**				

Optional Components - 60 Credits						
Elective code	**discipline code**	**Name of disciplines**	**Cycle**	**ESTS**	**lec/lab/pr/SRS**	**semester**
1201	AUT703	Modern control theory	Б	5	2/0/1/3	1
	AUT297	Integrated automation technology and management			2/0/1/3	
1202	AUT266	Data Mining Methods	Б	5	2/0/1/3	1
	AUT267	Intelligent technology in robotics			2/0/1/3	
1301	AUT709	New information technologies	П	5	2/0/1/3	1
	AUT285	Modern executive devices of automation systems			1/1/1/3	
1203	AUT264	MES systems	Б	5	2/0/1/3	2
	AUT217	Optimal control automation objects			2/0/1/3	
1302	AUT299	Diagnostics of system automation	П	5	2/0/1/3	2
	AUT700	The reliability of the management system and its elements			2/0/1/3	
1303	AUT271	Microprocessor control systems of technological processes	П	5	1/1/1/3	2
	AUT272	Systems for numerical programmable control of robots			1/1/1/3	
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2305	AUT237	Digital control systems	П	5	2/0/1/3	3
	AUT251	Dynamics of robot control			1/1/1/3	
2306	AUT701	Automation of control systems design	П	5	2/0/1/3	3
	AUT702	Automated projection of robotic systems			2/0/1/3	
2307	AUT225	Automation systems design	П	5	2/0/1/3	3
	AUT707	Distributed Control Systems			2/0/1/3	
2308	AUT228	Robotic technological complexes in discrete productions	П	5	2/0/1/3	3
	AUT231	Modern local automation and control systems			1/1/1/3	

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

Requirements for the level of training of a Master student are determined on the basis of Dublin descriptors of the second level of higher education (Masters) and reflect the mastered competencies expressed in the achieved learning results. Learning outcomes are formulated both at the level of the entire graduate education program and at the level of individual modules or an academic discipline.

The descriptors reflect learning outcomes that characterize the learner's abilities:

1) demonstrate developing knowledge and understanding in the field of automation, robotics, artificial intelligence and automated control, based on advanced knowledge in the field of automation, robotics, artificial intelligence and automated control, during the developing and (or) applying ideas in the context of research;

2) to apply at the professional level their knowledge, understanding and abilities to solve problems in a new environment, in a wider interdisciplinary context;

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

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

5) training skills necessary for independent continuation of further education in the field of automation, robotics, artificial intelligence and automated control.

6 Competence on completion of training

6.1 Requirements for key competencies of graduates of a *scientific and pedagogical Master's degree*: *1) have a knowledge:*

–about the role of science and education in public life;

–on current trends in the development of scientific knowledge;

–about the actual methodological and philosophical problems of the natural (social, humanitarian, economic) sciences;

–about professional competence of a higher education teacher;

–about the contradictions and socio-economic consequences of globalization processes; *2) know:*

–methodology of scientific knowledge;

–principles and structure of the organization of scientific activity;

–psychology of students' cognitive activity in the learning process;

–psychological methods and ways of improving the effectiveness and quality of education;

3) be able to:

–use the obtained knowledge for the original development and application of ideas in the context of scientific research;

–critically analyze existing concepts, theories and approaches to the analysis of processes and facts;

–integrate knowledge gained in various disciplines to solve the research problems in new unfamiliar conditions;

–by knowledge integration, make judgments and make decisions based on incomplete or limited information;

–apply the knowledge of pedagogy and psychology of higher education in their teaching activities;

–apply an interactive teaching methods;

–to carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;

–creatively think and solve new problems and situations;

–be fluent in a foreign language at a professional level, which allows to conduct research and teach special subjects at universities;

–summarize the results of research and analytical work in the form of a thesis, scientific article, report, analytical note, etc.; *4) have skills on:*

–research activities, solving standard scientific problems;

–implementation of educational and pedagogical activities on the credit technology of education;

–methods of teaching of professional subjects;

–use of modern information technology in the educational process;

–professional and intercultural communication;

–oratory, correct and logical design of their thoughts in oral and written form;

–Expansion and deepening of knowledge necessary for daily professional activities and continuing education in PhD studies.

5) be competent:

–in the field of research methodology;

–in the field of scientific and pedagogical activity in higher education institutions;

–in matters of modern educational technologies;

–in the implementation of research projects and scientific research in the professional field;

–in methods of continuous updating of knowledge, expansion of professional skills and abilities.

6.2 Requirements for the scientific research work of a master student in the scientific and pedagogical master's degree:

1) corresponds to the profile of the educational program of the master's degree program, where the master's thesis is carried out and defended;
2) relevant and contains scientific novelty and practical significance;
3) based on modern theoretical, methodological and technological achievements of science and practice;
4) performed using modern research methods;
5) contains research (methodical, practical) sections on the main protected provisions;
6) based on international best practices in the relevant field of knowledge.

6.3 Requirements for the organization of practices:

The educational program of the scientific and pedagogical master's degree includes two types of practices that are conducted in parallel with the theoretical training or in a separate period:

1) pedagogical in the cycle of base disciplines - at the university;
2) research in the cycle of profile disciplines - at the place where the thesis is carrying out.

The pedagogical practice is conducted with the aim of developing practical skills in teaching and learning. In this case, masters are attracted to conduct classes for the bachelor at the discretion of the university.

The research practice of the masters is conducted in order to familiarize them with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

7 Diploma Supplement by the standards of ECTS and MES RK

The Supplement is developed according to the standards of the European Commission, Council of Europe and UNESCO / CEPES. This document is for academic recognition only and does not constitute official proof of education. Without a diploma of higher education it is not valid. The purpose of completing the European Supplement is to provide sufficient information about the diploma owner, the qualifications obtained by him, 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. In the application model, which will be used for the transfer of estimates, the European system of transfer or credit transfer (ECTS) is used.

The European Diploma Supplement provides an opportunity to continue education in foreign universities, as well as to confirm national higher education for foreign employers. When traveling abroad for professional recognition it will be required additional legalization of the diploma of education. The European Diploma Supplement is completed in English language upon individual request and is issued free of charge.

8Disciplines description

Foreign language (professional)
CODE - LNG210
CREDIT - 5 (0/0/3)
PREREQUISITES - English language

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the course: the formation of professionally oriented competence in a foreign language among undergraduates.
Course objectives: to develop the ability to implement communicative intentions in different situations of professionally oriented oral and written communication based on four types of speaking activities: listening, speaking, reading and writing. Learning to use a foreign language as a means of gathering information for professional and academic communication. Preparing undergraduates to take a certified test.

BRIEF DESCRIPTION OF THE DISCIPLINE
The course is designed for undergraduates of technical specialties to improve and develop communication skills in a foreign language in the professional and academic spheres. The course acquaints students with the general principles of professional and academic intercultural oral and personal communication using modern pedagogical technologies (round table, discussions, discussions, analysis of professionally oriented situations, project).

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Upon completion of the course undergraduates:
- professionally oriented and academic means of foreign language communication;
- a system of rules for making meaningful statements in a foreign language; be able to use a foreign language as a means of oral and written communication for professional and academic purposes;
- express their opinion / judgment using the means of conveying and requesting information, evidence and evaluation;
- create an oral / written statement (depending on the ability to hear and / or read), expressing personal views on the topic of speech in a logical and consistent manner;
- knows how to use a foreign language as a means of professional and academic communication.

Science and history of philosophy
CODE - HUM210

CREDIT - 4 (1/0/1)
PREREQUISITES - Philosophy

GOALS AND OBJECTIVES OF THE DISCIPLINE
- to reveal the relationship between philosophy and science, to 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 issues of development of scientific and technical reality.

BRIEF DESCRIPTION OF THE DISCIPLINE
- subject of philosophy of science, dynamics of science, features of science, antiquity and formation of theoretical science, main stages of historical development of science, features of classical science, extracurricular and post-class science, philosophy of mathematics, physics, engineering and technology, features of engineering science, science ethics, social and moral responsibility of the scientist and the engineer.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
- knowledge and understanding of philosophical problems of science, the main historical stages of development of science, leading concepts of philosophy of science, ability to critically evaluate and analyze scientific and philosophical issues, understanding the specifics of engineering, analytical thinking and philosophical reflection, substantiation and defense; mastering the methods of discussion and dialogue, mastering the skills of communication and creativity in their professional activities.

High school pedagogy
CODE - HUM209

CREDIT - 4 (1/0/1)
PREREQUISITES - no

GOALS AND OBJECTIVES OF THE DISCIPLINE
The subject is aimed at studying the psychological and pedagogical significance of the educational process of higher education; formation of ideas about the main processes of higher education at the present stage, consideration of the methodological basis of the educational process in higher education, as well as psychological mechanisms that affect the success of the educational process, interaction, management of the subjects of the educational process. Development of psychological and pedagogical thinking for undergraduates.

BRIEF DESCRIPTION OF THE DISCIPLINE
In the course of the discipline undergraduates are included in the didactics of higher education, forms and methods of organization of higher education, psychological factors of successful teaching, features of psychological impact, pedagogical technologies, mechanisms of pedagogical communication, characteristics of pedagogical communication, learning management mechanisms. Analysis of organizational conflicts and ways to resolve them, psychological disorders and deformities of the teacher's personality.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
- At the end of the course undergraduates should know the features of the modern system of higher education, the organization of pedagogical research, the characteristics of the subjects of the educational process, the didactic basis of the organization of higher education, pedagogical technologies, pedagogical relations, features of education.

Management psychology
CODE - HUM208

CREDIT - 3 (1/0/1)
PREREQUISITES - no

GOALS AND OBJECTIVES OF THE DISCIPLINE
The main purpose of the discipline is to identify the characteristics of the behavior of groups and individuals within the organization, the psychological and social factors that affect the behavior of employees. Much attention is also paid to the issues of internal and external motivation of people. The main purpose of the discipline is to apply knowledge to increase the effectiveness of the organization.

BRIEF DESCRIPTION OF THE DISCIPLINE
Designed to provide balanced lighting of all the main elements that make up the discipline. It summarizes the emergence and development of the theory and practice of organizational behavior, and then considers the main role, skills and functions of management, with an emphasis on the effectiveness of management.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired by undergraduates during the course: the basics of individual and group behavior; basic theories of motivation; basic theories of leadership; concepts of communication, conflict and stress management in the organization; will be able to identify different roles of leaders in organizations; to look at the organization from the point of view of managers; Understands how effective management contributes to effective organization

MES-systems
CODE - AUT264

CREDIT - 5 (2/0/1)
PREREQUISITES - Integrated and microprocessor circuitry

GOALS AND OBJECTIVES OF THE DISCIPLINE
The classification of MES-functions determines their specific direction to achieve specific goals of improving production efficiency, taking into account the organizational structure of the industrial enterprise.

BRIEF DESCRIPTION OF THE DISCIPLINE
Data collection and storage is the interaction of information subsystems in order to obtain, collect and transmit technological and management data circulating in the production environment of the enterprise. Product quality management - analysis of real-time product quality measurement data based on information from the production level, ensuring proper quality control, identification of critical points and problems that require special attention.
Production process management - monitoring of production processes, automatic correction of operator decisions or dialog support. Management of maintenance and repair Management of scheduled and operational repairs of equipment and tools to ensure maintenance, operational readiness.
Tracking product history is the visualization of information about the place and time of work on each product. Information: executors, technological directions, components, materials, batch and serial numbers, carried out reconstruction, current production conditions, etc. may include reports on. Comparison of planned and actual indicators.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Expected results: the concept, architecture and technology of development and design of MES-systems in the creation of automation of production processes of enterprises with a continuous production cycle.

Methods of intelligent data analysis
CODE - AUT266

CREDIT - 5 (2/0/1)
PREREQUISITES - Intelligent control systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
Research of intelligent data processing and development of intelligent decision-making systems

BRIEF DESCRIPTION OF THE DISCIPLINE
The basis of intelligent data analysis methods are all possible methods of classification, modeling and prediction based on the use of solution trees, artificial neural networks, genetic algorithms, evolutionary programming, associative memory, fuzzy logic. Methods of intelligent data analysis include statistical methods (descriptive analysis, correlation and regression analysis, factor analysis, variance analysis, component analysis, discriminant analysis, time series analysis, viability analysis, relationship analysis). Such methods, however, assume some a priori notions of the data being analyzed, which are related to the purposes of intelligent data analysis (finding previously unknown non-privileged and practically useful knowledge).

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Undergraduates should know:
Skills and abilities are divided into descriptive and predictive.
The most important thing in the descriptive problems is to give a visual description of the existing hidden patterns, and in the preliminary reports there is a question of forecasting for cases where there is no data in the foreground.
The descriptive tasks include:

- search for associative rules or patterns (patterns);
- grouping of objects, cluster analysis;
- creation of a regression model.

The proposed tasks include:

- classification of objects (for pre-assigned classes);
- regression analysis, analysis of time series

Intellectual technologies in robotics
CODE - AUT267

CREDIT - 5 (2/0/1)
PREREQUISITES - Robotization of production processes

GOALS AND OBJECTIVES OF THE DISCIPLINE
Study of the general theory and basics of the design of intelligent technology in robotics

BRIEF DESCRIPTION OF THE DISCIPLINE
Emergence and stages of development of intelligent technologies in robotics. The main characteristics of robots: load capacity, coordinate displacement system, the number of degrees of movement; speed and travel of each joint, positioning error, method of installation in the workplace, maintenance work area. Principles of classification and construction of robotic systems. Technological requirements for robotic systems used in enterprises. The field of artificial intelligence is actively developing. Includes models, methods and algorithms aimed at the formation and automatic accumulation of knowledge based on the analysis and generalization of data. Examples include learning (or induction), as well as traditional approaches to image recognition theory.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
During the study of the discipline "Intellectual Technologies in Robotics" the teacher forms a knowledge base on the basics of the organization of the design process of intelligent robots, the principles of parallelization of design work, ways to achieve effective technical and economic parameters of products:
- know the basics of design activities of intelligent technologies in robotics;
- knowledge of the tool environment and methods of programming robotics systems;
- be able to effectively use analytical and digital methods and algorithms for solving robotics problems using programming languages and systems, computer mathematics systems, computer modeling tools;
- to be able to use the studied methods of designing robotic systems to solve problems of theoretical and applied nature.

Modern management theory
CODE - AUT703

CREDIT - 5 (2/0/1)
PREREQUISIT - Linear automatic control system

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Training of specialists who have mastered the methods of modern automatic control theory, able to independently solve its theoretical and applied problems of creating modern systems of automatic control.
Objectives of the discipline
Expansion and strengthening of specialists in the field of education, mastering new methods of theory of automatic control, methods of analysis and synthesis of control systems based on the state of space. Research of closed systems, methods of modal control, current identification, adaptation and effective control.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline includes the study of modern methods of analysis and synthesis of automatic control systems based on the methodology of "space conditions". The properties of spatial states, linear and nonlinear systems and methods of their study are considered in the unified method. Basic information on closed, modal control, identification, adaptation and optimization control systems is given.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- basic concepts and principles of technical objects of automatic control systems;
- development, analysis and synthesis of mathematical models to explain the theoretical rules of application of methods and techniques of technical objects of modern automatic control systems;
- development prospects and achievements of scientific and technical progress on the basis of technical objects of automatic control systems.
- the analysis of the performance, identifying the objects of management, the choice of tasks and methods of management, the class to be solved to determine the features;
- creation, identification, adaptation and effective management of algorithms for solving practical changes in the parameters of the production process;
- Management industry in modern computer systems for the implementation of tasks.

Diagnostics of elements of automation systems
CODE - AUT299

CREDIT - 5 (2/0/1)
PREREQUISITES - Automation technology

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Training of specialists to independently solve theoretical and applied problems related to the evaluation, analysis, diagnostics and reliability of automation systems and other complex technical systems.
Objectives of the discipline
Identification of types of digital reliability indicators, mastering the methods of analytical reliability assessment, calculation of reliability indicators based on test results and stages of development and operation, application of technical diagnostic methods in determining the location and causes of defects of diagnostic objects.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline is to study the characteristics of qualitative and digital indicators of reliability of technical systems, their probability and statistical assessment of test results, basic methods of calculating the reliability of recoverable and irreversible systems, selection and analysis of backup frequency, methods and models of technical diagnostics of automation systems.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- properties and indicators of reliability;
- digital indicators and mathematical models of reliability);
- basic methods of reliability calculation;
- types and plans of reliability tests;
- functions and features of the technical diagnostics system;
- The main methods of diagnosing automation systems.
As a result of studying the discipline must know:
- determination of digital reliability characteristics;
- use different calculation methods to determine the reliability of complex systems;
- determination of digital reliability indicators based on test results;
- practical implementation of technical diagnostic methods in assessing the performance of automation systems.

Reliability of the control system and its elements
CODE - AUT700

CREDIT - 5 (2/0/1)
PREREQUISIT - Automation technology

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Training of specialists to independently solve theoretical and applied problems related to the assessment, analysis and maintenance of reliability of control systems and their elements.
Objectives of the discipline
Development of types of digital indicators of reliability of various elements of control systems, including software, hardware and organizational software, calculation of reliability indicators based on test results and stages of development and operation, mastering the methods of analytical reliability assessment.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline includes a description of qualitative and quantitative indicators of reliability of control system elements, their probability and statistical evaluation of test results, study of basic methods of calculating the reliability of recoverable and irreversible systems, selection of backup coefficients and analysis of needs.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- properties and indicators of reliability;
- digital indicators and mathematical models of reliability);
- basic methods of reliability calculation;
- types and plans of reliability tests.
As a result of studying the discipline must know:
- determination of digital reliability characteristics;
- use different calculation methods to determine the reliability of control systems and their elements;
- determination of digital reliability indicators based on test results.

Microprocessor control systems of technological processes
CODE - AUT271

CREDIT - 5 (1/1/1)
PREREQUISITES - Mathematical modeling of automation objects

GOALS AND OBJECTIVES OF THE DISCIPLINE
Formation of knowledge on the principles of digital data processing, features of the organization of microprocessor devices and the use of microprocessors in technical facilities and process control systems, as well as skills in designing control systems based on microcontrollers and developing their application software

BRIEF DESCRIPTION OF THE DISCIPLINE
In this discipline, special attention is paid to the specifics of the use of software and logic controllers of production in the field of technical means of automation of leading firms, on the basis of which it is possible to create highly reliable control and process control systems. Learning to use different classes and organizational principles of microprocessor systems, mastering the skills of programming integrated systems. A certain place is given to the system, structural and logical stages of hardware and software design of microprocessor systems, the method of selection of microprocessor kits, features of processing and configuration of hardware and software of the system in cross-tools and resident mode. Microprocessor technology is widely used for control in industrial systems. The use of microprocessors in the management of distributed systems as a means of assembly and primary processing, transmission, conversion, as well as controllers of technological processes has expanded the functionality of sensors, actuators, peripherals and terminals.
This course provides undergraduates with the necessary knowledge and skills to solve industrial and scientific problems related to the selection of microprocessor tools for control systems.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Acquired knowledge: in the field of architecture and programming of standard microprocessor systems; methods and tools for designing automated modeling and microprocessor control systems; in the field of components for industrial automation systems and the range of controllers currently produced by suppliers.
Business: design of networks included in the objects of technological control and management, including on the basis of microprocessor control systems; reading and understanding of simple drawings of standard electronic equipment on the basis of digital integrated elements; selection of the necessary elements according to the reference information in accordance with the operating conditions of the elements in the scheme.

Skills: testing and tuning of microprocessor systems software in the implementation of ACS TP on their basis.

Digital control systems
CODE - AUT237

CREDIT - 5 (2/0/1)
PREREQUISITES - Information support of control systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Training of highly qualified personnel who know the basics of the use of digital control systems, in particular, mathematical methods of describing digital systems, methods of analysis in the field of time and frequency, studying the stability of digital systems and analyzing the calculation of digital systems.
Objectives of the discipline
Mathematical apparatus used to describe digital control systems, methods for determining the transfer function of the controller in a digital system, methods for studying the stability and quality of control processes in linearized digital control systems, methods for creating frequency characteristics of digital systems, methods for synthesizing digital controllers.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline "Digital Control Systems" includes the mathematical apparatus for describing digital systems, the description of digital systems in time and frequency zones, the synthesis of digital controllers in the automation of production processes.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- Mathematical models and methods of describing digital control systems;
- methods of studying the stability of digital control systems;
- methods of assessing the quality of the process of regulation of digital control systems;
- to set methods and problems of synthesis of digital controllers in the automation of production processes.
As a result of studying the discipline must know:
- analysis of technological processes for the creation of digital control systems;
- study of the stability of digital control systems;
- assessment of the quality of the process of regulation of digital control systems;
- based on the choice of the structure of the algorithm for digital control of a technical or technological system, depending on the specifics of the production process.

Dynamics of robot control
CODE - AUT251

CREDIT - 5 (1/1/1)
PREREQUISITES - Neural network robotics technologies

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Training of highly qualified personnel who know the basics of the dynamics of the robot control process in the robotization of production processes, in particular, mathematical methods for describing the kinematics of industrial robot manipulators, methods of software control of robots, description of dynamics of manipulative robots.
Objectives of the discipline
Methods and algorithms for matrix description of the kinematics of manipulative robots, solving direct and inverse problems of kinematics, synthesis of software trajectories on the degree of movement of the robot, description of the dynamics of the robot drive system, description of the dynamics of the robot manipulator. Models and algorithms for the control of industrial robots in robotic systems.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline "Dynamics of Robot Control" includes mathematical methods of cyclic, positional and contour control of industrial robots, models and algorithms of kinematic and dynamic analysis of industrial robots, kinematics and dynamics of manipulators and drive systems of industrial robots.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- Mathematical models and methods of adaptive control of the learning model;
- Mathematical models and methods of control adapted to the reference model;
- mathematical methods and control models adapted to the self-regulator;
- Mathematical models and algorithms for choosing a model of a serial-produced industrial robot in the construction of robotic systems;
- Mathematical models and algorithms for instantaneous sensing of industrial robots;
- Mathematical models and algorithms for the development of algorithms for adaptive control of industrial robots as part of a robotic system.
As a result of studying the discipline must know:
- analysis of technological operations, determining the parameters that require methods adapted to the control of robotic systems;
- adaptation of drives to the degree of movement of the manipulator depending on the changing parameters of the production process is based on the choice of the structure of the control algorithm;

- based on the choice of models and algorithms for instantaneous sensing of industrial robots;
- Analysis of the composition and structure of information and sensory systems to adapt the robot to the operating conditions.

Technical vision system
CODE - AUT706
CREDIT - 5 (2/0/1)

PREREQUISITES - Intellectual technologies in robotics

GOALS AND OBJECTIVES OF THE DISCIPLINE
Research of the robotic sensory system, which provides the perception of visual information about the external environment, the formation, processing and analysis of images of the work scene.
BRIEF DESCRIPTION OF THE DISCIPLINE
Technical vision system (TSS) is a special touch device that can be used to obtain high-quality images, their subsequent processing and conversion of a large information capacity of the KDS, and affects the level of information of more than 80% of the received data.
Data processing with the help of technical vision system is carried out hierarchically. Several video processors are used to reduce the image resistance level.
Being one of the most modern means of visual control, SID guarantees maximum production efficiency. A quality system provides an increase in productivity, as well as a significant simplification of the tasks. The effective use of visual control elements, such as a technical vision system, increases the amount of consumables, operating time and power, etc. b. allows you to save.
KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- Pixel counter: counts the number of light or black pixels
- Binary: binary image in gray (black and white pixels)
- Segmentation: Used to search and / or calculate details
- Reliable recognition by templates: search by template that can be returned, partially hidden by another object or different in size.
-Barcode reading: decoding of 1D and 2D codes designed for machine reading or scanning
- Optical character recognition: automatic reading of text, for example, serial numbers
- Measurement: Measure the size of an object in inches or millimeters
- Defining edges: search for edges of objects
- Comparison of templates: search, selection and / or calculation of specific models

Automation of control system design
CODE - AUT701
CREDIT - 5 (2/0/1)

PREREQUISITES - Automation of standard technological processes and productions

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Training of specialists who have mastered the theoretical foundations of design of control systems and methods of experimental and computational work on the creation and operation of automation systems on the basis of modern software and hardware.
Objectives of the discipline
Creation of mathematical models of objects and mastering of methods and algorithms of calculation of modern automatic control systems, selection of bases of automatic design of automation systems, their technical and mathematical support.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline "Automation of control systems design" is the study of methods of analysis and synthesis of control systems, calculation of parameters of the control law and the choice of structure. Procedures for analytical design of controllers, the development of structural, functional and other automation schemes using modern software packages (APPs) are considered.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- Methods of automation of mathematical models,
- Methods of analysis and synthesis of systems using modern software and hardware;
- modern packages of automated design systems;
- regulatory documents, state standards for the design of automation systems;
As a result of studying the discipline must know:
- analysis of technological processes to create a management system;
- based on the choice of the structure of the control method and algorithm, depending on the specifics of the production process;
- based on the choice of software and hardware of the control system and the use of modern packages of automated design.

Automated design of robotic systems
CODE - AUT702
CREDIT - 5 (2/0/1)
PREREQUISITES - Robotization of production processes

GOALS AND OBJECTIVES OF THE DISCIPLINE

The purpose of the discipline
Training of highly qualified personnel who know the basics of automation of robotic systems design, in particular, the composition and structure of the automated design system of robotic systems, methods and algorithms for selecting industrial robot models, assembly drawings, development of algorithms for robotic systems.
Objectives of the discipline
Mathematical, software, information, technical support of automated design systems of robotic complexes. Models and algorithms for choosing the type of industrial robot, the creation of assembly drawings of robotic systems, the development of algorithms for the control of robotic systems.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline "Automation of robotic system design" is the composition and structure of the automated system for designing robotic systems, mathematical models and algorithms for choosing a robot model, the layout of the robotic system, the development of industrial robot control algorithms and manipulators. includes the study of the drive system of an industrial robot.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Knowledge acquired during the course:
- Mathematical methods for the development of networks and elements of robotic systems;
- The structure and content of mathematical, software and information software for automatic design of robotic systems;
- the structure and composition of technical means used in automated systems for the design of robotic systems;
- Mathematical models and algorithms for choosing a model of a serial-produced industrial robot in the construction of robotic systems;
- Mathematical models and algorithms for creating schematic diagrams of robotic systems;
- Mathematical models and algorithms for the development of algorithms for the control of industrial robots in a robotic system.
- analysis of technological operations as objects of robotization;
- based on the choice of the structure of the manipulator, the type of drive of the manipulator, the type of robotic control system depending on the type of production process;
- based on the choice of the type of component scheme of the robotic system, depending on the type of production process;

- Analysis of the kinematic and dynamic capabilities of serial-produced robots used as part of a robotic system.

Integrated control automation technologies
CODE - AUT297
CREDIT - 5 (2/0/1)
PREREQUISITES - Mathematics, physics

GOALS AND OBJECTIVES OF THE DISCIPLINE
The main purpose of the course is to provide the future specialist with the necessary knowledge in the field of information technology development, the general principles of creating information systems capable of creating automated information systems, their operation and development, the creation of integrated automated control systems
Objectives of the course. An important task is to create conditions for future professionals to master all the diversity of scientific and technological advances and practical experience in the use of information technology. Guided by the diversity of information resources, understanding the principles of creation and development of automated information systems, the future Information Systems specialist needs information about the general principles of creation, operation and development of information systems, the role of information systems in solving various organizational systems.
BRIEF DESCRIPTION OF THE COURSE
The course "Integrated Management Automation Technologies" presents sections - the concept of control systems and classification, management information support, principles of automated information systems, the creation of integrated automated control systems, the main stages of the life cycle of automated information systems.
KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE
Studying this discipline allows students to use mathematical methods for solving optimization problems, to develop algorithms for software implementation of tasks, to create software products according to the developed algorithms, to perform software product repair and testing.

New information technologies
CODE - AUT709
CREDIT - 5 (2/0/1)
PREREQUISITES - ATPiP, LSAR, NSAU

GOALS AND OBJECTIVES OF THE DISCIPLINE

New information technologies are a wide range of disciplines and areas of activity related to data management and processing technologies, including the use of computer technology. In the past, information technology was often understood as computer technology. In particular, ASUTP uses computers and software to store, modify, protect, process, transmit and receive information. Computer hardware and programming specialists are often referred to as ASUTP specialists. The study of IIoT technology also includes advanced analytical platforms that process data from Internet-connected equipment and connected devices. IIoT devices can range from small weather sensors to sophisticated industrial robots. Learn new advanced technologies such as Industrial Networks and Interfaces, Industrial Networks, Can Technology, Profibus, Fieldbus Foundation, Modbus RTU, TCP IP, ASCII.

BRIEF DESCRIPTION OF THE COURSE

The course "New Information Technologies" covers new aspects of industrial automation, in particular, new interface technologies and data exchange technologies.

KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE

Studying this discipline allows undergraduates to apply their knowledge and practical skills in production, development of new automated systems.

Modern actuators of automation systems

CODE - AUT285

CREDIT - 5 (1/1/1)

PREREQUISITES - Design of automation systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
The main purpose of teaching this subject is to teach undergraduates to choose the right devices in automation systems, to explain that actuators are the most important element in automation systems, their correct calculation and selection determines the main quality indicators of the system.
The methodical manual of the lecture course on the subject "Modern actuators of automation systems" provides the basis for the principle and theory of operation of actuators, the correct and effective selection and calculation of actuators of automation systems.
Here are the basic definitions and explanations related to the use of actuators in industrial automation.

Robotic technological complexes in discrete industries
CODE - AUT228
CREDIT - 5 (2/0/1)
PREREQUISITES - Robotization of production processes

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline Development of algorithms and cyclograms for the control of robots, training of highly qualified personnel who know the basics of creating cyclic, positional and contour systems of software control of robots, digital software control systems for machines, machines.
Discipline objectives: әзір Development of algorithms and cyclograms of robots in a robotic system, methods of development of cyclic, positional and contour systems of robot control systems, numerical control systems of machines, machines.
BRIEF DESCRIPTION OF THE COURSE
The content of the discipline "Robotic technological complexes in discrete industries" includes the study of mathematical methods of software control of robots, the basics of developing algorithms and cyclograms of robot control. The structure and composition of cyclic, positional and contour systems of software control of robots, digital software control systems of machines, machines are considered.
KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE
As a result of studying the discipline you need to know:
- methods of creating algorithms and cyclograms for the control of robots in a robotic system;
- cyclic, positional and contour systems of software control of robots;
- architecture of software control systems for machines, machines and robots;
- electro-automation of software control systems; ;
- Basics of programming digitally controlled machines. As a result of studying the discipline must know:

- analysis of robotic objects to select the necessary system of software control of robots and process equipment;
- Analysis of the operation of the electro-automation system and the formation of the necessary connections with the software control system and process equipment of the robot;
- assessment of the quality of management of robots and software control systems of production processes;
- programming of robots and digital software control systems of production processes.

Modern local automation and control systems
CODE - AUT231
CREDIT - 5 (1/1/1)
PREREQUISITES - Linear automatic control systems. Local government systems.

GOALS AND OBJECTIVES OF THE DISCIPLINE
The main purpose of the course is to form knowledge and skills of undergraduates in modeling, analysis and synthesis of modern local automation and control systems. During the course, undergraduates master the theoretical foundations of modern local systems based on modern methods of modeling, analysis and synthesis.
Objectives of the course: Undergraduate's knowledge of modeling, analysis and synthesis of modern local automation and control systems based on digital systems, numerical control, mathematical analysis, control in space, empirical methods, methods of synthesis of standard controllers.

BRIEF DESCRIPTION OF THE COURSE
The course "Modern local automation and control systems" contains the following sections: Mathematical modeling of modern local automation and control systems based on the theory of digital systems, state space; methods of analysis of modern local automation and control systems; control methods in the state space; modern methods of synthesis of standard regulators.

KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE
Upon completion of the course, the undergraduate must demonstrate the ability to model, analyze and synthesize modern local automation and control systems.
Undergraduates must be able to: implement algorithms for modeling, analysis and synthesis of modern local automation and control systems; mastering the theoretical foundations of the synthesis of standard regulators for modern local systems; Solve problems of modeling, analysis and synthesis of local systems as a result of performing numerical and analytical calculations and the use of computers.
Undergraduates must know: Theoretical bases of mathematical modeling of modern local systems of control and automation based on the theory of digital systems, state space; Methods of analysis of modern local automation and control systems; methods of control in the state space; modern methods of synthesis of typical regulators.

Digital software control systems for robots
CODE - AUT272
CREDIT - 5 (1/1/1)
PREREQUISITES - Microcontrollers in control systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline - the development of algorithms and cyclograms for the control of robots, training of highly qualified personnel who know the basics of creating cyclic, positional and contour systems of software control of robots, digital software control systems for machines, machines.
Objectives of the discipline - Development of algorithms and cyclograms of robots in a robotic system, methods of development of cyclic, positional and contour systems of software control of robots, digital software control systems of machines, machines.
BRIEF DESCRIPTION OF THE COURSE
The content of the discipline "Numerical software control systems for robots" includes the study of mathematical methods of software control of robots, the basics of developing algorithms and cyclograms of robots. The structure and composition of cyclic, positional and contour systems of software control of robots, digital software control systems of machines, machines are considered.
KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE
As a result of studying the discipline you need to know:
- methods of creating algorithms and cyclograms for the control of robots in a robotic system;
- cyclic, positional and contour systems of software control of robots.

Optimal control systems
CODE - AUT705
CREDIT - 5 (2/0/1)
PREREQUISITES - Modern management theory

GOALS AND OBJECTIVES OF THE DISCIPLINE

The purpose of the discipline

Has the basics of research and development of optimal control systems based on classical variational computational methods, in particular, training of highly qualified personnel who know the basics of software and stabilization optimal control, elements of classical variational computation, basics of maximal and dynamic programming.

Objectives of the discipline

Methods of the theory of optimal control, elements of classical variational calculus, the basics of the principle of maximum and dynamic programming. Models and methods of software and stabilization optimal management.

BRIEF DESCRIPTION OF THE COURSE

The content of the discipline "Optimal Control System" includes the study of mathematical methods of optimal control, the basics of the maximum principle and the method of dynamic programming on the basis of classical variational calculations. Models and methods of software and stabilization optimal management are considered. Methods of synthesizing intelligent intelligent control systems are considered separately.

KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE

As a result of studying the discipline you need to know:

- Mathematical models and methods for creating optimal control systems based on classical variational computational elements;
- Mathematical models and methods of optimal control based on the principle of maximum;
- Mathematical models and optimal control methods based on the method of dynamic programming;
- Mathematical models and methods of creating optimal control systems based on the method of analytical design of regulators;
- Mathematical models and methods for creating optimal control systems in the event of accidental external influences;
- Mathematical models and methods for creating optimal control systems in the presence of incomplete information about the vector of state variables.

As a result of studying the discipline must know:

- analysis of technological processes to create optimal control systems;
- based on the choice of the structure of the optimal control algorithm of the technical or technological system, depending on the specifics of the production process;
- based on the choice of the type of model and algorithm (including intelligent) for optimal control of the technical or technological system.

Automation of technical systems
CODE - AUT708
CREDIT - 5 (2/0/1)
PREREQUISITES - Automation and control in technical systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline is to train specialists who can quickly master modern information technologies and use them to solve problems arising in the practice of development and implementation of design and technological projects in engineering enterprises.
Objectives of the course - to study the basic principles of architecture of automated systems of technological preparation of production, taking into account the trends of modern industrial production and the development of new information technologies.

BRIEF DESCRIPTION OF THE COURSE
The methodological basis for the creation of an automated system of technological preparation of production (ADS) was considered. Taking into account the development trends of modern industrial production and new information technologies for its automation, the basic principles of creating the architecture of the SDS are formulated. CAD and its structure. Introduction. General concept of design. Structural model of CAD. CAD subsystems. Types of security. Methods of construction. Organization of the design process. Systematic approach to design. Ways to reduce the design time of complex technical systems. Information support. Mathematical support. CALS-technologies. Identification and assignment of CAD / CAE / CAM systems. Levels of CAD / CAE / CAM systems. Modularity of CAD / CAE / CAM systems. Integration in CAD / CAE / CAM systems.

KNOWLEDGE, SKILLS, SKILLS UNTIL COMPLETING THE COURSE
Knowledge acquired during the course:
- Best domestic and foreign experience in the field of complex automated systems
- methodology, IPI / CALS standards, technical requirements for the product life support system
- Basic principles of creating the architecture of UTDAZ
- Methods of creating an object-oriented model of CCI and its implementation by means of PDM systems
Skills and abilities acquired during the course (professional, managerial, communicative):

- Development of 3D models of parts, execution of operational sketches for individual technological operations
- Creation and execution of a set of technological documents in an automated mode

Design of automation systems
CODE - AUT225
CREDIT - 5 (2/0/1)
PREREQUISITES - Design of automation systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline is to train specialists who have mastered the theoretical apparatus that underlies the modern theory of design of automation systems, able to perform research work on the design and operation of control systems on the basis of modern computer equipment.
Objectives: during the course it is necessary to prepare undergraduates to work in the field of design of automation systems, mastering the basic principles and mathematical methods, theoretical and practical bases of analysis and synthesis of automation systems on the basis of modern methods.

BRIEF DESCRIPTION OF THE DISCIPLINE
The course includes the following methodologies:
- Methods of automation of mathematical models,
- methods of analysis and synthesis of systems using modern means of computer technology and automation of scientific research;
- modern trends in the development of science and technology and their impact on automation;
- regulatory documents, state standards for the design of automation systems, the essence of the system approach in the design, the requirements for modern control systems;
- The structure and purpose of the state system of instruments; various structural and functional schemes of control systems; Basic Algorithms that ensure the operation of typical industrial regulators; technical means of automation systems; modern computer hardware and software.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
During the training undergraduates must gain theoretical knowledge, practical skills and abilities in the field of automation systems design; must master the theoretical foundations, basic principles and mathematical methods of systems design; must master the methods of automation of mathematical models, analysis

and synthesis of systems using modern means of computer technology and automation of scientific research; acquaintance with the development trends of science and technology and their impact on automation; regulatory documents for the design of automation systems, state standards, the essence of the system approach in the design, the requirements for modern control systems; structure and purpose of the state system of instruments; various structural and functional schemes of control systems; basic algorithms that ensure the operation of standard industrial regulators; technical means of automation systems; study of modern hardware and software of computer technology.

Distributed control system
CODE - AUT707
CREDIT - 5 (2/0/1)
PREREQUISITES - Local government systems

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline
Highly qualified personnel who know the basics of creating distributed control systems in various industries, in particular, methods of mathematical description of distributed control systems using individual derivative differential equations, methods of studying the stability and quality assessment of distributed control systems, structure and composition of distributed control systems preparation.
Objectives of the discipline
Methods and algorithms for the creation of distributed control systems in various industries, methods of mathematical description, the study of the stability and quality assessment of the process of regulation of distributed control systems. Methods of developing the structure and composition of hardware, software modules and information support for distributed control systems.

BRIEF DESCRIPTION OF THE DISCIPLINE
The content of the discipline "Distributed control systems" consists of the study of the quality of the management process of distributed systems, the study of sustainability, the study of mathematical methods of description. The choice of the structure and composition of hardware and software for distributed control systems is considered.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
As a result of studying the discipline should know ::
- Mathematical models and methods for describing distributed control systems;

- Mathematical models and methods for studying the stability of distributed control systems;
- Mathematical models and methods for assessing the quality of the management process of distributed control systems;
- methods of creating the structure and selection of hardware and software for the creation of distributed control systems.

Knowledge acquired during the course:
- analysis of technological processes for the creation of distributed control systems;
- based on the choice of the structure of the control algorithm of distributed control systems, depending on the specifics of the production process;
- conduct research to determine the sustainability of the distributed management system and assess the quality of the management process of the distributed management system.

Effective management of automation facilities
CODE - AUT217
CREDIT - 5 (2/0/1)
PREREQUISITES - Mathematics II; Method of optimization; Mathematical bases of systems theory

GOALS AND OBJECTIVES OF THE DISCIPLINE
The purpose of the discipline: to study and master the methods of solving extreme problems arising in the creation of computer software automation objects, to study the computer and use it in solving real problems of computer software.

BRIEF DESCRIPTION OF THE DISCIPLINE
The discipline considers the main aspects and features of technological processes. Requirements for an effective control system and an effective process control system. Establishing an effective management report. Forming an extreme problem. Algorithms based on the solution of ancillary problems. Iterative algorithms. Linear programming. Effective management of multistage processes. Classical variational methods of effective control. Application of the principle of maximum in solving the problem of effective management.

KNOWLEDGE AND SKILLS TO COMPLETE THE DISCIPLINE
Possible solutions: the undergraduate should know: the basic methods of solving extreme problems of software; methods of solving effective management problems for well-defined objects; methods for solving the problem of effective management

for objects that are not clear enough; algorithms and procedures for solving various extreme problems.
Postrequisites: Methods of intelligent data processing, Optimal control systems (with IS elements), defense of master's dissertation.

The program of scientific and pedagogical master's degree includes two types of practice:
- pedagogical;
- research.
Pedagogical practice is carried out in order to develop practical skills and teaching methods.
Pedagogical practice can be carried out at the stage of theoretical training without interruption of the learning process.
The research practice of the undergraduate is carried out in order to get acquainted with new theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.
Master's research work
Research work in scientific and pedagogical magistracy:
- compliance with the main issues of the specialty for which the master's dissertation is defended;
- relevance, scientific novelty and practical significance;
- based on modern theoretical, methodological and technological achievements of science and practice;
- performed using modern research methods;
- maintenance of research (methodical, practical) sections on the main protected rules;
- based on international best practices in the field of education.
- performed with the use of advanced information technologies;
- maintenance of experimental-research (methodical, practical) sections on the main protected rules.

Registration and defense of the master's dissertation
CODE - ECA205
CREDIT - 12

The purpose of the master's dissertation:
Demonstrate the level of research skills of the undergraduate, the ability to conduct research independently, to test the ability to solve specific scientific and practical problems, to know the general methods and techniques for solving them.

BRIEF DESCRIPTION
Master's dissertation is a graduate qualifying scientific work, which has an internal unit and reflects the process and results of the development of the chosen topic, one of the key issues of a particular specialty in the relevant field of science.
Master's dissertation is the result of research, experimental research work carried out by the undergraduate at all stages of study.
The defense of the master's dissertation is the final stage of master's training. The master's dissertation must meet the following requirements:
- The work should address pressing issues in the field of automation, robotics, artificial intelligence and automated control;
- The work should be based on the identification and solution of important scientific problems;
- decisions must be scientifically based and reliable, have internal unity;
- The dissertation must be written individually.
Demonstration of the level of research skills of the undergraduate, the ability to conduct their own research, the ability to solve certain scientific and practical problems, knowledge of common methods and techniques for their solution.

Content