

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ УКРАЇНИ
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
ІМЕНІ ІГОРЯ СІКОРСЬКОГО»
Механіко-машинобудівний інститут
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СЕРТИФІКАТНА ПРОГРАМА

**«МЕХАТРОННІ І РОБОТОТЕХНІЧНІ СИСТЕМИ В
МАШИНОБУДУВАННІ»**

«MECHATRONIC AND ROBOTIC SYSTEMS IN MECHANICAL ENGINEERING»

ЗА

ОСВІТНЬО-ПРОФЕСІЙНОЮ ПРОГРАМОЮ

«АВТОМАТИЗОВАНІ ТА РОБОТИЗОВАНІ МЕХАНІЧНІ СИСТЕМИ»

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3. Syllabuses of the educational components of the certificate program

1. DESCRIPTION OF THE CERTIFICATE PROGRAM

| 1 - General information | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Full name of higher education institution and faculty/department | National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute" (Education and Research Institute of Mechanical Engineering, Department of Applied Hydroaeromechanics and Mechatronics) | |
| Degree of higher education | Degree of higher education - first (bachelor's) | |
| Subject area (field of knowledge, specialty) | Field of knowledge - 13 "Mechanical engineering, specialty 131 "Applied mechanics" | |
| The official name of the certificate program | Mechatronic and robotic systems in mechanical engineering | |
| Type of certificate and scope of the certificate program | Certificate of the established model NTUU «Igor Sikorsky Kyiv Polytechnic Institute», 56 credits | |
| Language of teaching | Ukrainian | |
| Validity period of the certificate program | Indefinitely | |
| The Internet is the address of permanent placement of the certificate program | http://pgm.kpi.ua/uk/pro-kafedru/dokumenty-kafedry https://mmi.kpi.ua/abituriientu/spetsialnosti-ta-spetsializatsii?id=730 http://osvita.kpi.ua/131-arms | |
| 2 – Purpose of the certificate program | | |
| Deepening of knowledge in the field of creation and operation of mechatronic systems and robotic complexes, acquisition of applied skills and abilities that ensure the implementation of general and professional competencies in the training of specialists in the field of automation of production processes | | |
| 3 – Peculiarities of participation of students of the Certificate program | | |
| Candidates of the certificate program can be students of NTUU «Igor Sikorsky Kyiv Polytechnic Institute», as well as external listeners. External trainees are required to pass a test to check their knowledge of the disciplines "Machine parts", "Hydraulics", "Informatics", which are the basis for mastering, deepening knowledge and skills during training under the certificate program. The certificate program is designed for 3rd and 4th year full-time students. Enrollment in the program takes place during the period when students exercise their right to freely choose academic disciplines for the next academic year. | | |
| 4 – List of educational components | | |
| <i>Components of the certificate program</i> | <i>Number of ECTS credits</i> | <i>Final control form</i> |
| <i>Elective educational components</i> | | |
| Synthesis of discrete control systems | 4 | test |
| Hydro- and pneumatic motors of mechatronic systems | 4 | test |
| Fundamentals of electronics | 4 | test |
| Logical synthesis of control algorithms | 4 | test |
| Electric hydraulic drive mechatronic systems | 4 | test |
| Pneumatic actuators with electrical control | 4 | test |
| Robots and manipulators in mechanical engineering | 4 | test |

| | | |
|----------------------------------------------------------------------|------------------------|------|
| Proportional hydraulics | 4 | test |
| Electrohydraulic automation mechatronic systems | 4 | test |
| Mathematical modeling and design of physically heterogeneous systems | 4 | test |
| Computer modeling of mechatronics and robotics systems | 4 | test |
| Computer design of mechatronics and robotics modules | 4 | test |
| Innovative devices of mechatronics | 4 | test |
| Electronic means of control and management of mechatronic systems | 4 | test |
| Total credits of the certificate program | 56 ECTS credits | |

5 – Competencies and expected learning outcomes

The certificate program provides for the deepening of competences and the specialization of learning outcomes obtained during the study of the disciplines "Discrete control systems of executive devices", "Basics of mathematical modeling of physically heterogeneous systems", "Basics of construction and design", "Design of aggregates of automated mechanical systems", " Computer design modules of mechatronics and robotics". This certificate program is aimed at students' assimilation of the peculiarities of the creation and use of machines, systems and devices of mechatronics and robotics, taking into account the practical problems of the field of application. It is filled with unique content developed together with stakeholders , author's courses, which are based on the use of industrial equipment and are characterized by practicality and relevance, which allows you to gain additional knowledge and skills, expand the range of career opportunities in the field of machine-building automation.

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|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Competencies enhanced by the certificate program | <ul style="list-style-type: none"> ➤ Ability to describe and classify a wide range of technical objects and processes, based on deep knowledge and understanding of basic mechanical theories and practices, as well as basic knowledge of related sciences ➤ The ability to choose rational approaches and technical means for the creation, testing and operation of control systems of technical objects and systems, machines and mechanisms with means of mechanics, hydropneumatic automation , electromechanics, mechatronics and robotics ➤ The ability to choose rational approaches and technical means for the automation of technical objects and systems, machines and mechanisms by means of mechanics, hydropneumatic automation , electromechanics, mechatronics and robotics, to create competitive technical objects, to apply criteria for evaluating their functional, operational, energy and general efficiency ➤ The ability to use instrumental means of construction, justify and develop rational constructive solutions of automated mechanical systems, machines, systems of hydropneumatic automation , electromechanics, mechatronics and robotics and their elements and aggregates, in accordance with the given operational, functional, economic, ergonomic and other requirements when solving practical problems ➤ The ability to use modern approaches and tools of automated design to create automated mechanical systems, machines, systems of hydropneumatic |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>automation , electromechanics, mechatronics and robotics and their components to ensure the performance of specified functions, operational characteristics and performance indicators</p> <ul style="list-style-type: none"> ➤ The ability to use modern tools for the development of mathematical and simulation models of automated mechanical systems, machines, systems of hydro-pneumatic automation , electromechanics, mechatronics and robotics and their components in order to determine rational design and operational parameters, modes and conditions of operation, assessment of functionality and efficiency by computer modeling |
| <p>Expected learning outcomes</p> | <ul style="list-style-type: none"> ➤ mechatronics and robotics tools and devices in automated machine building systems. ➤ Knowledge of the basics of automated control for solving applied problems of automation of production and operational systems. ➤ Knowledge of applied programs and approaches to determining rational parameters and characteristics of systems and devices of mechatronics and robotics by means of computer modeling. ➤ The ability to build information models of the subject of research: describe its essential parameters, input and variable values, establish cause-and-effect relationships between them. ➤ The ability to set the task of designing a new mechatronic system or modernizing an existing one, and implement it using modern software products and technical means. ➤ The ability to use the means of information technologies of design in the tasks of technical preparation of production. ➤ The ability to determine, by means of computer modeling, the characteristics and rational parameters of systems and devices of mechatronics and robotics. ➤ multi-mode control systems and algorithms mechatronic and robotic systems in mechanical engineering. |
| <p>6 - Peculiarities of evaluation of learning outcomes</p> | |
| <p>Each educational component of the certificate program has a corresponding methodical support, a mandatory part of which is the rating system used to evaluate the training results of the applicants. According to the decision of the department, the completion of an individual task may be provided for obtaining a certificate under this certificate program.</p> | |

STRUCTURE OF THE CERTIFICATE PROGRAM

| Type of educational component | The name of the educational component | Semester | Number of credits | One hour per week | Form of control |
|-------------------------------|----------------------------------------------------------------------|----------|-------------------|-------------------|-----------------|
| 1st year of study | | | | | |
| Selective | Synthesis of discrete control systems | 5 | 4 | 4 | test |
| Selective | Hydro- and pneumatic motors of mechatronic systems | 5 | 4 | 4 | test |
| Selective | Fundamentals of electronics | 6 | 4 | 4 | test |
| Selective | Logical synthesis of control algorithms | 6 | 4 | 4 | test |
| Selective | Electric hydraulic drive mechatronic systems | 6 | 4 | 4 | test |
| Selective | Pneumatic actuators with electrical control | 6 | 4 | 4 | test |
| 2 year of study | | | | | |
| Selective | Robots and manipulators in mechanical engineering | 7 | 4 | 4 | test |
| Selective | Proportional hydraulics | 7 | 4 | 4 | test |
| Selective | Electrohydraulic automation mechatronic systems | 7 | 4 | 4 | test |
| Selective | Mathematical modeling and design of physically heterogeneous systems | 7 | 4 | 4 | test |
| Selective | Computer modeling of mechatronics and robotics systems | 7 | 4 | 4 | test |
| Selective | Computer design of mechatronics and robotics modules | 8 | 4 | 4 | test |
| Selective | Innovative devices of mechatronics | 8 | 4 | 4 | test |
| Selective | Electronic means of control and management of mechatronic systems | 8 | 4 | 4 | test |

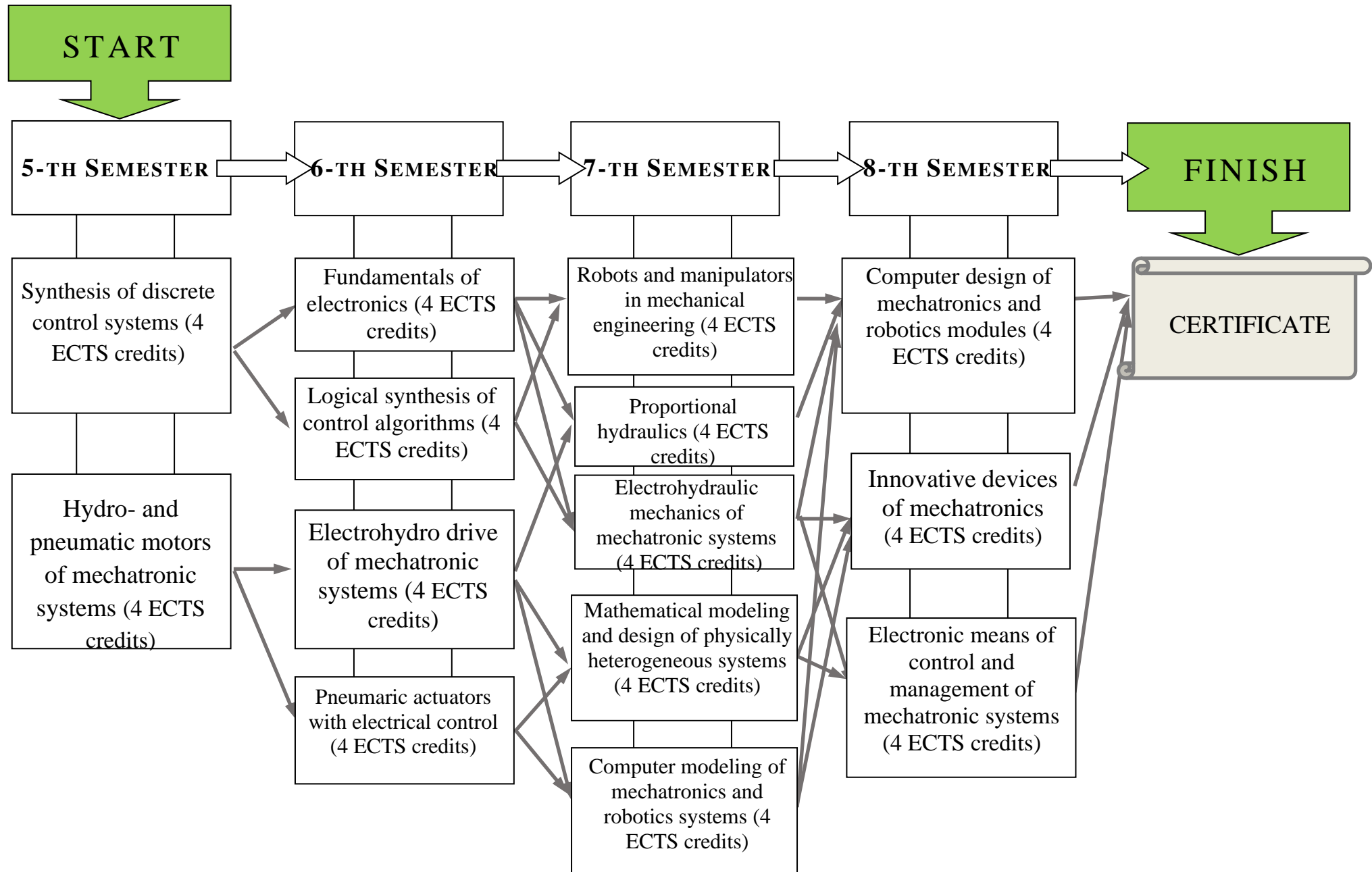
In order to receive a certificate, it is necessary to successfully listen to and learn the specified optional educational components.

The total volume of the certificate program is 56 credits.

In order to increase the level of professional and practical training, students studying under the educational program "Automated and Robotic Mechanical Systems" must take into account the specialization of the chosen certificate program when

completing pre-diploma practice and completing the thesis (the topic of the work is agreed separately with the head of the certificate program).

CERTIFICATE PROGRAM ROADMAP



Conditions for participation in the certificate program

The program is designed for students who have basic knowledge in the field of mechanics, electrical engineering, design, modeling of processes and systems.

Enrollment of trainees in the certificate program is carried out on the basis of the submitted application, while:

- external students submit an application no later than April of the current academic year to enroll them for the next academic year;
- students studying under the educational program "Automated and robotic mechanical systems" submit applications within the established deadlines for enrollment in optional disciplines.

Assessment

The assessment will take place in accordance with the Regulation on the system of assessment of learning outcomes at NTUU «Igor Sikorsky Kyiv Polytechnic Institute». The conditions for obtaining and distributing points for each educational component of the certificate program are reflected in the relevant syllabuses .

Release requirements

Completed educational program of 56 ECTS credits.

Based on the results of the student's mastery of the certificate program, acquisition of certain professional knowledge, abilities and skills, a certificate of NTUU «Igor Sikorsky Kyiv Polytechnic Institute». Information about mastering the certificate program is indicated in the annexes to the diploma of the European model.

2. Descriptions of educational components of the certificate program

| Discipline | Synthesis of discrete control systems |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksandr Gubarev, Oksana Ganpanturova, Alona Murashchenko |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired in the study of disciplines "Theoretical Mechanics", "Computer Science", "Physics", "Fundamentals of design and engineering" |
| What will be studied | Principles of construction and architecture of mechatronic systems of discrete action, elements of graph theory. Automation of technological processes, separate functions and technical objects by means of mechatronics. Formal description of cyclic and closed processes in objects of discrete action, functional and system modules. Research and supplement system memory. Logical synthesis of systems by cyclic-modular approach. Assembly, testing and debugging of typical discrete control systems for mechatronics. Search for system errors, expanding the range of automated functions. |
| Why it is interesting / necessary to study | Mechatronics is the basis for the creation of intelligent machines, and the synthesis of control systems with open architecture is a prerequisite for the application of developments in the Industry 4.0 platform. It is impossible to automate the control of complex systems without understanding the physics of controlled processes, and the synthesis process is a means of transforming the structure of a complex physical and mechanical process into the logic of subordination of individual actions and functions, which is the main content of this discipline. |
| What can be learned (learning outcomes) | Perform analysis of automation objects using conceptual models and principles of construction of cyclic and closed systems of discrete action. Cyclic-modular structure of system elements. Methods of synthesis, research, addition and minimization of discrete control systems of mechatronics. Principles of construction of PLC control algorithms. |
| How to use the acquired knowledge and skills (competencies) | Solve practical problems of automation by means of mechatronics. Develop schemes and control algorithms for automated mechanical systems. Select a modern element base of control systems, compile, debug and diagnose algorithms and control systems of mechatronics of typical systems. |
| Information support | Training and working programs of the discipline, RSD, lecture notes (electronic edition), textbook (electronic edition) |
| Form of classes | Lectures, laboratory classes, individual task |
| Semester control | Test |

| Discipline | Hydro- and pneumatic motors of mechatronic systems |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Hryshko |
| Requirements for the beginning of the study | Successful mastery of knowledge and skills acquired in the study of the disciplines "Mathematics", "Physics", "Theory of machines and mechanisms", "Machine parts", "Fundamentals of construction and design" |
| What will be studied | The principle of operation of various volumetric machines (manual, gear, gerotor, screw, plate, axial and radial piston, which are used in mechatronic systems). Features of their design and operation in different modes of operation, because mechatronic systems must be very flexible. |
| Why it is interesting / necessary to study | Understanding the principle of operation of a volumetric machine makes it possible to competently, reasonably select, if necessary, assemble or develop, one of the main components of the hydraulic system. |
| What can be learned (learning outcomes) | <p>Clearly understand the capabilities and applications of different in their design and output parameters of hydraulic and pneumatic machines.</p> <p>Understanding the functional significance of any pump or motor component for any mechatronic system.</p> <p>Ability to choose the necessary type of hydraulic and pneumatic machines for specific parameters and tasks.</p> <p>Calculation of the main parameters of hydraulic and pneumatic machines.</p> <p>On own experience to evaluate the work of hydraulic and pneumatic machines in different modes of operation of the mechatronic system.</p> |
| How to use the acquired knowledge and skills (competencies) | <p>The acquired theoretical knowledge makes it possible to easily understand the operation of any hydraulic system. Identify possible malfunctions and predict its operation.</p> <p>Practical experience gained through close cooperation with the company "HIDRAVLIK Line" gives the skills to work with hydraulic equipment of any complexity.</p> |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition) |
| Form of classes | Lectures, laboratory classes, independent work |
| Semester control | Test (written test) |

| Discipline | Fundamentals of electronics |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied radio electronics |
| Teachers | Andrii Movchaniuk |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired in the study of disciplines "Physics", "Mathematics", Synthesis of discrete control systems". |
| What will be studied | The course is devoted to the study of the physical principles of operation and application of semiconductor devices for signal processing in mechatronic systems, in-depth study of certain sections of the theory of electrical circuits and electrical signals. Separately, the issue of the basics of computer modeling of electronic systems is presented. |
| Why it is interesting / necessary to study | The very concept of mechatronics includes a combination of mechanics and electronics, so without studying the basics of electronics it is impossible to be a full-fledged specialist. Using the means of electronics, you can build control systems, digital and computer data processing systems, etc. Therefore, a modern engineer must understand the basics of electronic devices and systems. |
| What can be learned (learning outcomes) | As a result of training, the student will be able to understand the principles of operation and application of the main types of semiconductor electronic devices for analog and digital systems, as well as the basics of analog signal processing. |
| How to use the acquired knowledge and skills (competencies) | After studying the discipline, the student will be able to better understand the processes occurring in electronic systems and independently design the simplest electronic systems. |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition) |
| Form of classes | Lectures, practical classes, laboratory classes, independent work |
| Semester control | Test (written test) |

| Discipline | Logical synthesis of control algorithms |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksandr Gubarev, Oksana Ganpanturova, Alona Murashchenko |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired in the study of disciplines "Theoretical Mechanics", "Computer Science", "Physics", "Fundamentals of design and engineering" |
| What will be studied | Principles of construction of systems and algorithms of control of mechatronics objects on the basis of PLC. Logical synthesis of control algorithms using algorithmic languages STL, LD, ST. Consideration of the type of devices in control algorithms. Memory elements, timers, counters and subroutines in control algorithms. Assembly, testing and debugging of typical control algorithms for mechatronics systems. Search for system errors, expanding the range of automated functions. |
| Why it is interesting / necessary to study | Logical synthesis is a tool for transforming developer knowledge into algorithms for the operation and management of an automated object. The use of controllers and distributed systems instead of hardware controls is indispensable for the automation of mechanical systems. The cyclic-modular approach allows to build mechatronic systems with open architecture, ie suitable for qualitative and quantitative modernization, which is the main content of the discipline. |
| What can be learned (learning outcomes) | Perform a logical synthesis of algorithms for the operation of typical cyclic systems of mechatronics Conclude typical control algorithms for mechatronic systems based on algorithmic languages STL, LD, ST Take into account the technical means of executive, control and monitoring devices in the control algorithms of mechatronics |
| How to use the acquired knowledge and skills (competencies) | Develop typical control algorithms for practical automation problems by means of mechatronics Develop schemes of control systems using PLC, select the element base, compile, debug and diagnose control algorithms |
| Information support | Curriculum and working programs of the discipline, RSD, lecture notes (electronic edition) |
| Form of classes | Lectures, laboratory classes, independent work, individual task |
| Semester control | Test |

| Discipline | Electric hydraulic drive mechatronic systems |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Teachers | Konstantin Belikov, Oksana Ganpanturova |
| Department | Applied hydroaeromechanics and mechatronics |
| Requirements for the beginning of the study | Successful mastery of the knowledge and skills acquired in the disciplines "Hydraulic and pneumatic motors of mechatronic systems", "Mechanics of materials and structures", "Discrete control system synthesis", "Fundamentals of design and engineering" |
| What will be studied | Design and calculation of the main parameters of hydraulic drives. Design and principle of operation of elements of hydraulic systems. Hydraulic systems for industrial purposes. Electrical control of hydraulic system elements. Detectors and sensors of hydraulic systems. |
| Why it is interesting / necessary to study | The hydraulic drive is widely used in heavily loaded automated industrial lines, mobile construction machines and robots. Understanding the operation of the hydraulic drive system and its control is necessary, both at the level of a separate hydraulic unit and as a whole. |
| What can be learned (learning outcomes) | Fundamentals of hydraulic apparatus design. Calculation and selection of power drives for hydraulic systems. Calculation of hydraulic lines and selection of electro-hydraulic devices for mechatronic systems. |
| How to use the acquired knowledge and skills (competencies) | Design of mechatronic systems based on hydraulic drive. Creation of technical proposals and designs. Design engineering documentation. |
| Information support | Study and work programme of the discipline, rating system of assessment, lecture notes (electronic publication), textbook for laboratory practicals (electronic publication). |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test (written test) |

| Discipline | Electric pneumatic drive |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleh Levchenko, Olexander Haletskiy |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Informatics", "Physics", "Electrical engineering", "Synthesis of discrete control systems" |
| What will be studied | Principles of operation of pneumatic actuators with electric control. Automation of production processes and technical objects by means of electropneumatic automation. Formal description of pneumatic drive objects and study of static and dynamic characteristics. Research and correction of system and hardware malfunctions, modernization of control systems. |
| Why it is interesting / necessary to study | Large number of enterprises, especially in the field of food and pharmaceutical industries, use the pneumatic actuators with electric control as the main type of drive. High-quality operation and maintenance of such systems requires highly qualified personnel. |
| What can be learned (learning outcomes) | Basic principles of construction and use of typical solutions of pneumatic actuators with electrical control. Methods of development, research, addition of electric control of pneumatic systems. Approaches to equipment selection, assembly, debugging, modernization and troubleshooting. |
| How to use the acquired knowledge and skills (competencies) | To solve practical tasks of automation of technical facilities by creating electrical control systems of pneumatic actuators. Develop schematic solutions and documentation for electrical control systems of pneumatic actuators using electropneumatic controls. Select the element base of control systems. Assemble, debug and diagnose of pneumatic drive control systems and put them into operation. |
| Information support | Educational and work programs of the discipline, RSE, lecture notes (electronic edition), study guide (electronic edition) |
| Form of classes | Lectures, laboratory classes, individual tasks |
| Semester control | Test (written evaluation test) |

| Discipline | Robots and manipulators in mechanical engineering |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Nochnichenko, Kostiantyn Belikov |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines: "Informatics", "Basics of mathematical modeling of physically heterogeneous systems", " Basics of construction and design", "Theory of mechanisms and machines", "Informatics", "Discrete control systems of executive devices". |
| What will be studied | Basic concepts and varieties of robots and manipulators, schematic and constructive solutions of modern robots, kinematic diagrams of industrial robots, calculation of kinematics of industrial robots, basic algorithms and programs for programming robots, necessary approaches for rational use of modern information technologies in solving problems related to with modeling and manufacturing of robots. |
| Why it is interesting / necessary to study | It is difficult to imagine a modern machine-building complex and factories, conveyors and production sites without the use of robots and manipulators during assembly, manufacturing, mechanical processing in the key of Industry 4.0. |
| What can be learned (learning outcomes) | Determination of typical malfunctions of the hydro-pneumosystem; installation and trial start-up of the hydro-pneumosystem; determination of equipment protection methods against vibration; conducting tests of hydro and pneumatic systems and equipment; maintenance of hydraulic and pneumatic systems, drives, control and automation tools in technical systems. |
| How to use the acquired knowledge and skills (competencies) | Build, develop, test and research mathematical models of mechatronics and robotics systems, taking into account the modes and conditions of their operation; the ability to increase the degree and quality of existing objects by modernizing mechatronics and robotics systems using innovative mathematical modeling approaches and software packages. |
| Information support | Textbooks, study guides, virtual labs, packages of group labs |
| Form of classes | Lectures, laboratory |
| Semester control | Assessment (written assessment) |

| Discipline | Proportional hydraulics |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Oksana Ganpanturova, Konstantin Belikov |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired during the study of disciplines "Electrical Engineering and Electronics", "Fundamentals of Electronics", "Electric Hydro Drive of Mechatronic Systems", "Electric Drive of Mechatronic Systems", "Synthesis of Discrete Control Systems for Actuators" |
| What will be studied | Development and construction of hydraulic circuits based on proportional hydraulics devices. Types and principle of construction of structures of hydraulic devices with proportional control. Performance characteristics and operating parameters of valves with proportional control. Practical issues of application of drives with proportional control. Designs and principle of operation of hydraulic servos, areas of application of servos. |
| Why it is interesting / necessary to study | The development and modernization of the hydraulic drive is also associated with full or partial automation of work processes. The use of proportional hydraulics allows you to expand the functionality of the hydraulic drive, reduce the number of equipment and add automated control, including from the controller. That is why a modern engineer needs basic knowledge of the design features of hydraulic devices with proportional control, the ability to create schemes based on proportional hydraulics and practical skills to adjust the parameters of the system. |
| What can be learned (learning outcomes) | To carry out development and calculations of designs of hydraulic devices with proportional control and the hydraulic drives constructed on their basis. Know the methods of design and modernization of hydraulic control systems. Acquire practical skills in creating, commissioning, operation and modernization of mechatronic systems based on proportional control hydraulic devices. |
| How to use the acquired knowledge and skills (competencies) | To carry out assembly, adjustment and diagnostics of the mechatronic system with proportional devices in its composition and put it into operation. Improve the degree and quality of existing facilities by upgrading the control system and / or hardware using innovative approaches to the development of mechatronic systems. |
| Information support | Curriculum and working programs of the discipline, RSD, lecture notes (electronic edition), textbook, guidelines for laboratory work |
| Form of classes | Lectures, laboratory classes, independent work, individual task |
| Semester control | Test |

| Discipline | Electrohydraulic automation mechatronic systems |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksandr Luhovskyi |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines «Fundamentals of electronics», «Logical synthesis of control algorithms», «Electro-hydraulic drive of mechatronic systems», «Synthesis of discrete control systems» |
| What will be studied | Acquaintance with methods of automatic control in hydraulic systems of mechatronic means of automation and robotics. Acquaintance with methods of programming automatic control systems. Acquaintance with examples of implementation of hydraulic automatic control systems in automation tools and industrial works. Acquaintance with methods of calculation and modeling of electrohydraulic amplifiers, determination of their characteristics. |
| Why it is interesting / necessary to study | In production, many technological processes require automation and robotization. Production requires the creation of mechatronic automated and robotic complexes that will free a person from participating in the technological process, which will increase the productivity and quality of mechanical engineering products. |
| What can be learned (learning outcomes) | You can learn the basic principles of building automatic control hydraulic systems. Learn the basic ways of programming similar automation systems. To study the element base of modern hydraulic mechatronic automatic control systems. Understand examples of implementation of analog and discrete hydraulic automatic control systems. |
| How to use the acquired knowledge and skills (competencies) | Calculate and design hydraulic systems of automatic mechatronic control. Develop basic hydraulic schemes for automation systems. Develop design documentation for mechatronic automatic control systems. Select a modern element base for mechatronic systems Automation. |
| Information support | Textbooks, study guides, virtual laboratory work, packages of group laboratory work, packages of professional application programs |
| Form of classes | Lectures, practical, laboratory |
| Semester control | Test |

| Discipline | Mathematical modeling and design of physically heterogeneous systems |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Lecturers | Oleksandr Uzunov, Oleksandr Galeckij, Igor Nochnichenko |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Higher Mathematics", "General Physics", "Theoretical Mechanics", "Theory of Mechanisms and Machines", "Basics of construction and design", "Fluid and Gas Mechanics", "Basics of mathematical modeling of physically heterogeneous systems". |
| What will be studied | Examples of systems with physically heterogeneous components and their distribution into typical functional components. Software tools for modeling processes. Peculiarities of dynamic processes mathematical models building of and the forms of mathematical dependencies representation. The concept of the second generation simulation modeling. A library of typical elements for building models. Model testing and evaluation indicators of physically heterogeneous systems. Analytical method for evaluating the work capacity and accuracy of systems in steady state. Formulation of the design problem of a physically heterogeneous system and the design algorithm. Development of a functional and principle diagram of a technical system. Transformation of the schematic diagram into a mathematical model. Testing, adjusting the model of a physically heterogeneous system and determining its parameters that will provide the predicted characteristics. |
| Why it is interesting / necessary to study | Mathematical modeling of the action of elements and systems requires their understanding both at the level of principles and at the level of the influence of parameters on their characteristics. Having learned to build models and simulate technical systems, students receive a powerful tool for their research and design. |
| What can be learned (learning outcomes) | You will be able to understand the principles of operation and the structure of physically heterogeneous systems; the principles of dividing systems into typical elements and approaches to building mathematical models; to develop mathematical models to determine static and dynamic characteristics; to evaluate the influence of parameters on the characteristics of elements and systems; to design elements and systems. |
| How to use the acquired knowledge and skills (competencies) | Acquired knowledge and skills are used to develop mathematical models, modeling and designing elements and systems with physically heterogeneous components. |
| Information support | Textbooks, study guides, virtual laboratory work, packages of group laboratory work, packages of professional application software. |
| Form of classes | Lectures, laboratory classes, independent work |
| Semester control | Test |

| Discipline | Computer modeling of mechatronics and robotics systems |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Nochnichenko |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired during the study of disciplines: "Informatics", "Fundamentals of mathematical modeling of physically heterogeneous systems", "Fundamentals of construction and design". |
| What will be studied | Basic concepts and characteristics of mathematical modeling methods. Basic equations characterizing physically heterogeneous systems: hydraulic, pneumatic, mechanical, electrical, etc.. Analysis of some generalized mathematical models of mechanical, hydraulic, pneumatic systems and processes of the foundations of mathematical modeling of physically heterogeneous systems and modules; theoretical positions of approaches to mathematical modeling of physically heterogeneous systems and processes; synthesis, methods and mechanisms (stages) of building mathematical models. The physical essence of phenomena and processes occurring in technical objects. |
| Why it is interesting / necessary to study | The ability to numerically evaluate the efficiency of physically diverse systems, using complex criteria and modern methods of construction and system engineering, to solve specific practical problems of the machine-building complex. Mathematical modeling is one of the main stages in the development, testing, research and design of modern modules of the machine-building complex. |
| What can be learned (learning outcomes) | Formation of mathematical models that make it possible to carry out physical and mathematical modeling; Build, develop, test and research mathematical models of mechatronics and robotics systems, taking into account the modes and conditions of their operation, using innovative mathematical modeling approaches and software packages. |
| How to use the acquired knowledge and skills (competencies) | To improve the quality of existing facilities through modernization and reengineering of physically heterogeneous systems, to carry out optimization using innovative technical solutions and approaches. |
| Information support | Textbooks, study guides, virtual labs, packages of group labs |
| Form of classes | Lectures, laboratory |
| Semester control | Assessment (written assessment) |

| Discipline | Computer design of mechatronics and robotics modules |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Hryshko |
| Requirements for the beginning of the study | Successful mastery of knowledge and skills acquired in the study of the disciplines "Fundamentals of computer design", "Robots and manipulators in mechanical engineering", "Proportional hydraulics", "Computer modeling of mechatronics and robotics systems", "Mathematical modeling and design of physically heterogeneous systems". |
| What will be studied | General principles of work in CATIA CAD 3D. |
| Why it is interesting / necessary to study | Mastering the skills of working in a variety of specialized 3D modeling programs contributes to the development of engineering skills and expands the range of work programs that are successfully used in leading companies. |
| What can be learned (learning outcomes) | <p>Creation of parametric sketches.</p> <p>Creating solid parts in a variety of ways.</p> <p>Work with complex surfaces.</p> <p>Work with a sheet body.</p> <p>Creation of assembly units taking into account the constraints imposed on the component.</p> <p>Creating working drawings from previously developed 3D components.</p> <p>Work with specialized applications for creating pipelines.</p> |
| How to use the acquired knowledge and skills (competencies) | <p>The acquired skills allow you to fully express yourself as a design engineer.</p> <p>This course is aimed at developing engineering thinking with the integrated application of previously acquired knowledge in various subjects.</p> <p>The complexity of the work is expressed in the independent development of the course project.</p> |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition) |
| Form of classes | Lectures, practical exercises, independent work. Individual task - calculation and graphic work. |
| Semester control | Test (written test) |

| Discipline | Innovative devices of mechatronics |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksandr Luhovskyi, Andriy Zilinskyi |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines «Electrohydroautomatics of mechatronic systems», «Hydromechanics and hydraulics», «Synthesis of discrete control systems», «Fundamentals of mathematical modeling of physically heterogeneous systems», «Computer modeling of mechatronics and robotics systems» |
| What will be studied | Schematic and structural solutions of executive devices of mechatronic systems based on piezoelectric electromechanical transducers of sound and ultrasonic ranges will be studied. Methods of calculation, modeling and experimental research of such innovative executive devices will be considered. Logistic support of automated production. |
| Why it is interesting / necessary to study | The executive devices considered allow to increase the efficiency of many technological processes in mechanical engineering, chemical industry, medicine and agriculture, which use the effects that accompany the phenomenon of ultrasonic cavitation in the organization and management of through-flow material flows in production. |
| What can be learned (learning outcomes) | You can learn how to create innovative executive devices that are the latest in the world. All devices that students will be introduced to are protected by patents of Ukraine. The proposed methods of calculating resonance systems of the specified devices will allow students to advance in the field of creating innovative mechatronic systems. |
| How to use the acquired knowledge and skills (competencies) | The acquired knowledge and skills will allow the student to create modern mechatronic systems to automate and increase the efficiency of many technological processes in mechanical engineering, the chemical industry, medicine and agriculture. |
| Information support | Study and work programs of the discipline, RS (rating system), lecture notes (electronic edition), study guide (electronic edition) |
| Form of classes | Lectures, practical, laboratory |
| Semester control | Test |

| Discipline | Electronic means of control and management of mechatronic systems |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Andrii Movchaniuk |
| Requirements for the beginning of the study | Successful mastery of knowledge and skills acquired in the study of the disciplines "General physics", "Fundamentals of electronics", "Fundamentals of industrial electric drive", "Electrohydroautomatics of mechatronic systems", "Synthesis of discrete control systems", "Mathematical modeling and design of physically heterogeneous systems" |
| What will be studied | Passive linear circuits, their transmission functions and main characteristics. Active analog linear circuits, their transmission functions and basic characteristics. Signal amplifiers on bipolar and field effect transistors. Main characteristics of amplifying stages and principles of their calculation. Fundamentals of circuit construction on operational amplifiers. Fundamentals of digital circuitry. Combinational digital circuits and their implementation. Basics of synthesis of digital automata. Principles of analog-to-digital and digital-to-analog conversion. |
| Why it is interesting / necessary to study | Mechatronic system is a combination of electronic means that control the actuating mechanisms. At the same time, the electronic control system is entrusted with the tasks of processing signals from feedback sensors, signal processing, and generating drive control signals. The future specialist must necessarily understand the processes taking place in the electronic part of the mechatronic system. |
| What can be learned (learning outcomes) | The basics of digital and analog electronic means of mechatronic systems. Understand the principles of amplification and filtering of analog signals. Understand the principles of digital circuit construction and conjugation of analog and digital circuits. To read electrical circuit diagrams. Understand the features of the element base. |
| How to use the acquired knowledge and skills (competencies) | After completing the course, you can design elements of electronic mechatronics systems. To measure the operating modes of electronic components of mechatronic systems. Formulate tasks, select or order the necessary electronic system. |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition) |
| Form of classes | Lectures, laboratory classes, individual tasks |
| Semester control | Test (written test) |