National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"
Educational and Scientific Mechanics and Machine-Building Institute

APPROVED
Vice Rector for Academic Affairs
_____ Anatolii MELNYCHENKO
«___» _____ 20___

# P-Catalogue elective academic disciplines

for applicants for a Bachelor's degree
in the educational and professional programme
" Automated and robotics mechanical systems "
speciality 131 Applied Mechanics

Approved
Methodical council
Ihor Sikorsky KPI
(protocol №___ from «___»_____20___)

Academic council of educational and scientific
Mechanical Engineering Institute
of Ihor Sikorsky KPI
(protocol №___ from «___»_____20___)

KYIV 2022

According to Section X of Article 62 of the Law of Ukraine 'On Higher Education' (No 1556-VII of 01.07.2014), elective disciplines are disciplines of students' free choice for a certain level of higher education, aimed at providing general and special (professional) competences beyond the speciality. The volume of elective disciplines is not less than 25% of the total number of ECTS credits.

Selected disciplines from the departmental F-Catalogue students choose in accordance with the "Regulations on the implementation of the right to free choice of academic disciplines by students of Ihor Sikorsky KPI ES MMI".

The P-Catalogue includes disciplines of free choice involved in the formation of professional competences, in accordance with the educational programme. The P-Catalogue contains an annotated list of disciplines offered for choosing by students of the first (Bachelor) level of higher education according to the educational programme.

2nd year students of the first (Bachelor) level of higher education choose the disciplines from the P-Catalogue for the third year of education.

3rd year students in the first (Bachelor) level of higher education choose the disciplines from the P-Catalogue for the fourth year of study.

2nd year students have the right to choose to study under a certificate programme approved by the University Order in accordance with the established procedure and to receive, together with their diploma, a certificate of the approved form.

Disciplines from the P-Catalogue are selected through the "my.kpi.ua" system. The summarised information is used to plan the educational process.

**SELECTION OF DISCIPLINES FROM THE P-CATALOGUE**
**students studying under an educational and professional program**
**"Automated and robotics mechanical systems"**
**for the 2022/2023 academic year**

1. Acquaintance with the "Regulations on the procedure of exercising by students of the Igor Sikorsky Kyiv Polytechnic Institute the right to free choice of academic disciplines".
2. Acquaintance with the departmental catalogue of elective study disciplines (hereinafter referred to as P-Catalogue).
3. In the second year of study at the first (Bachelor's) level the applicant must choose 6 professional disciplines from the cycle of free choice for the first and second semesters of the third year of study or choose a certificate programme with a specified list of free choice disciplines for the third and fourth year of study.
4. In the third year of the first (Bachelor's) study level, the applicant shall select 8 professional disciplines from the free choice cycle for the first and second semester of the fourth year of study, if he/she is not studying in the selected certificate programme.
5. Implementation of students' choice of academic disciplines from the formed P-Catalogue in the system my.kpi.ua (supervised by group supervisors to ensure participation of all students in the procedure of selection of disciplines and correctness of the choice).
6. Then the results of the choice of disciplines and the formation of study groups for each discipline, taking into account the normative number of students in the group.
7. In case of impossibility to form study groups to study a particular discipline with the normative number of students, students are given the opportunity to re-select by joining the already formed study groups.

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**"Automated and robotics mechanical systems"**
**for 2022/2023**

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**Table 1. Procedure for choosing disciplines by course and semester**

| ***Study COURSE-Semester*** | ***Освітня програма АРМС за спеціальністю 131 Прикладна механіка*** | *Discipline 1* | *Teacher* | *Discipline 2* | *Teacher* | *Discipline 3* | *Teacher* | *Credits* |
|---|---|---|---|---|---|---|---|---|
| ***3 course – 1 semester*** | ***Educational component 1*** | Synthesis of discrete control systems | **Oleksandr Gubarev, Oksana Ganpantsurova, Alona Murashchenko** | Machine-building hydraulics | **Natalia Seminska, Alona Murashchenko** | Industrial technologies and the basics of engineering logistics | **Yurii Danylchenko** | **4** |
| | ***Educational component 2*** | Hydro- and pneumatic motors of mechatronic systems | **Ihor Hryshko** | Volumetric hydraulic and pneumatic machines and hydraulic transmissions | **Ihor Hryshko** | Construction mechanics and metal structures LTM | **Oleksii Niezhentsev** | **4** |
| ***3 course – 2 semester*** | ***Educational component 3*** | Fundamentals of electronics | **Andrii Movchaniuk** | Gasdynamics | **Volodymyr Turyk** | Fundamentals theory of three-dimensional modeling | **Andrii Titov** | **4** |
| | ***Educational component 4*** | Logical synthesis of control algorithms | **Oleksandr Gubarev, Oksana Ganpantsurova, Alona Murashchenko** | Compressor machines | **Konstantin Belikov** | Fundamentals theory of automatic control | **Oleksandr Okhrimenko** | **4** |
| | ***Educational component 5*** | Electric hydraulic drive mechatronic systems | **Konstantin Belikov, Oksana Ganpantsurova** | Volumetric hydraulic drive | **Oksana Ganpantsurova** | Hydraulic power drive of lifting and transport machines (LTM) | **Dmytro Kostiuk** | **4** |
| | ***Educational component 6*** | Pneumaric actuators with electrical control | **Oleh Levchenko, Olexander Haletskiy** | Pneumatic Actuators and Pneumatic Control Systems | **Olexander Haletskiy** | Lifting machines | **Yurii Horbatenko, Andrii Petryshyn** | **4** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***4 course – 1 semester*** | ***Educational component 7*** | Robots and manipulators in mechanical engineering | **Ihor Nochnichenko, Kostiantyn Belikov** | Applied hydromechanics | **Oleg Yakhno, Dmytro Kostiuk** | Robotics of logistics systems | **Ihor Nochnichenko, Oleh Levchenko** | **4** |
| | ***Educational component 8*** | Proportional hydraulics | **Oksana Ganpantsurova, Konstantin Belikov** | Mobile hydraulics | **Oleh Levchenko, Oleksandr Haletskiy** | Transport machines | **Yurii Horbatenko, Andrii Petryshyn** | **4** |
| | ***Educational component 9*** | Electrohydraulic automation of mechatronic systems | **Oleksandr Luhovskyi** | Machine-building hydraulic automation | **Oleksandr Luhovskyi, Andriy Zilinskyi** | Production and sales logistics | **Yurii Danylchenko, Andrii Petryshyn** | **4** |
| | ***Educational component 10*** | Mathematical modeling and design of physically heterogeneous systems | **Oleksandr Uzunov, Oleksandr Galeckij, Igor Nochnichenko** | Mathematical modeling and design of hydraulic and pneumatic drive systems | **Oleksandr Uzunov, Oleksandr Galeckij, Igor Nochnichenko** | Transport and warehouse logistics | **Andriy Petryshyn, Pavlo Protsenko** | **4** |
| | ***Educational component 11*** | Computer modeling of mechatronics and robotics systems | **Ihor Nochnichenko** | Hydraulic and pneumatic turbomachines and transmissions | **Dmytro Kostiuk** | Automated electric drive and basics of electric automation | **Vasyl Lukavenko**, **Andrii Zilinskyi** | **4** |
| ***4 course – 2 semester*** | ***Educational component 12*** | Computer design of mechatronics and robotics modules | **Ihor Hryshko** | Designing of hydraulic and pneumatic drives | **Serhii Nosko** | Technology and logistics of automated production | **Yurii Danylchenko, Andrii Petryshyn** | **4** |
| | ***Educational component 13*** | Innovative devices of mechatronics | **Oleksandr Luhovskyi, Andriy Zilinskyi** | Computational hydromechanics of hydraulic components | **Dmytro Kostiuk** | Introduction to mechatronics | **Alona Murashchenko** | **4** |
| | ***Educational component 14*** | Electronic means of control and management of mechatronic systems | **Andrii Movchaniuk** | Testing and diagnostics of drive systems | **Ihor Nochnichenko** | Operation and maintenance of lifting and transport machines | **Oleksii Niezhentsev** | **4** |

## *Educational component 1.1*

| Discipline | Synthesis of discrete control systems |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits (120 hours) |
| Language of instruction | Ukrainian, English |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksandr Gubarev, Oksana Ganpantsurova, 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.<br>Automation of technological processes, separate functions and technical objects by means of mechatronics.<br>Formal description of cyclic and closed processes in objects of discrete action, functional and system modules.<br>Research and supplement system memory.<br>Logical synthesis of systems by cyclic-modular approach.<br>Assembly, testing and debugging of typical discrete control systems for mechatronics.<br>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. |
| Why you can learn (learning outcomes) | Perform analysis of automation objects using conceptual models and principles of construction of cyclic and closed systems of discrete action.<br>Cyclic-modular structure of system elements.<br>Methods of synthesis, research, addition and minimization of discrete control systems of mechatronics.<br>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.<br>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 |

## *Educational component 1.2*

| Discipline | Machine-building hydraulics |
|---|---|
| Course | 3, fall semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teachers | Natalia Seminska, Alona Murashchenko |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the disciplines «Physics», «Fundamentals of design and engineering» |
| What will be studied | The course studies the basic laws of equilibrium and movement of fluids, the use of energy of working fluids. Hydraulics occupies the first place in the application of industry, in particular in hydraulic engineering, thermal power engineering. «Machine-building hydraulics» studies applications in the field of volumetric, hydraulic and pneumatic drives. |
| Why is it interesting/should be studied? | Designing and creating modern drives is not possible without studying the basics of machine-building hydraulics. It is important to study the laws and characteristics of working fluids. The correct use of liquid energy in drives makes it possible to create various mobile, powerful, autonomous devices that have a wide range of applications. |
| Why you can learn (learning outcomes) | The main tasks of studying the course « Engineering hydraulics" are mastering the basics of hydraulics; familiarization with the existing types of hydraulic machines, hydraulic and pneumatic drives and their characteristics and properties; mastering the methods of determining parameters of operating modes of hydraulic machines, hydraulic and pneumatic drives. |
| How to use acquired knowledge and skills (competencies) | Ability to solve problems in professional activities based on analysis and synthesis.<br>The ability to theoretically substantiate the decisions made in the process of design and construction work in the field of mechanical engineering.<br>The ability to justify the choice, determine the operating parameters of the automated production equipment of machine-building enterprises and design their typical units.<br>Ability to analyze technical and economic and operational indicators of hydraulic machines, hydraulic and pneumatic drives, their systems and elements. |
| Lesson (study) | Lectures, practical, laboratory |
| Information support | Study and work programs of the discipline, RS (rating system), lecture notes (electronic edition), study guide (electronic edition) |
| Individual semester assignments | Calculation work |
| Current control | Modular control work / implementation and protection of the results of laboratory and practical work, express control, etc |
| Semester control | Test |

## *Educational component 1.3*

| **Discipline** | **Industrial technologies and the basics of engineering logistics** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Yurii Danylchenko |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired while studying the discipline "Technology of construction materials" |
| What will be studied | Industrial technologies: branches of production, technologies of material production, production and technological processes. Basics of the organization of production processes: classification of production by types and strategies, structure and forms of production organization, phases of production preparation. Infrastructure of industrial enterprises: infrastructure of the commodity market, production structure of a machine-building enterprise, production infrastructure, structure of the production cycle. Basics of engineering logistics: macro- and macro-logistics, objects of logistics management, material flows, logistics systems, logistics planning. |
| Why it is interesting / necessary to study | The successful operation of any industrial enterprise in a market economy is determined by the competitiveness of its products, which is primarily achieved by minimizing production and logistics costs in changing market conditions. The solution of this task is based on a set of knowledge about the technology of industrial production and the organization and functioning of an industrial enterprise in interaction with suppliers of materials and consumers of products. |
| What you can learn (learning outcomes) | The purpose of the discipline is the formation of primary system knowledge regarding the organization of production processes, analysis of the infrastructure of the commodity market and the development of the production structure and infrastructure of a machine-building enterprise, taking into account the technological and logistical components of production processes. This knowledge is basic for further mastering methods and means of automation of production processes, as well as analysis of existing and design of new production and logistics systems. |
| How to use the acquired knowledge and skills (competencies) | Analyze various production processes by production flow and by level of organizational hierarchy. To distinguish technological and logistical components of production processes. To justify the forms of organization and phases of production preparation. To solve the main problems of material and technical support of the manufacturer, related to procurement logistics and maintenance of stocks. |
| Information support | Study and work programs of the discipline, rating system, lecture notes (electronic edition). |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test (written test) |

## *Educational component 2.1*

| **Discipline** | **Hydro- and pneumatic motors of mechatronic systems** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | 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. |
| Why you can learn (learning outcomes) | Clearly understand the capabilities and applications of different in their design and output parameters of hydraulic and pneumatic machines.<br>Understanding the functional significance of any pump or motor component for any mechatronic system.<br>Ability to choose the necessary type of hydraulic and pneumatic machines for specific parameters and tasks.<br>Calculation of the main parameters of hydraulic and pneumatic machines.<br>On own experience to evaluate the work of hydraulic and pneumatic machines in different modes of operation of the mechatronic system. |
| How to use the acquired knowledge and skills (competencies) | The acquired theoretical knowledge makes it possible to easily understand the operation of any hydraulic system. Identify possible malfunctions and predict its operation.<br>Practical experience gained through close cooperation with the company "HIDRAVLIK Line" gives the skills to work with hydraulic equipment of any complexity. |
| 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) |

## *Educational component 2.2*

| **Discipline** | **Volumetric hydraulic and pneumatic machines and hydraulic transmissions** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | 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). Features of their design and operation in different modes. |
| Why it is interesting / necessary to study | Understanding the principle of operation of a volumetric machine makes possible to competently, reasonably select, if necessary, assemble or develop, one of the main components of the hydraulic system. |
| Why you can learn (learning outcomes) | Clearly understand the possibilities and applications of different in their design and output parameters of volumetric machines.<br>Understand the functional value of any pump or motor component.<br>Ability to choose the necessary type of volumetric machine for specific parameters and tasks.<br>Calculation of the main parameters of volumetric machines.<br>On own experience to evaluate the work of volumetric machines in different modes. |
| How to use the acquired knowledge and skills (competencies) | The acquired theoretical knowledge makes it possible to easily understand the operation of any hydraulic system. Identify possible malfunctions and predict its operation.<br>Practical experience gained through close cooperation with the company "HIDRAVLIK Line" gives the skills to work with hydraulic equipment of any complexity. |
| Information support | Study and work programs of the discipline, rating system of evaluation, lecture notes (electronic edition). |
| Form of classes | Lectures, laboratory classes, independent work |
| Semester control | Test (written test) |

## *Educational component 2.3*

| **Discipline** | **Construction mechanics and metal structures of lifting and transporting machines** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits (120 hours) |
| Language of instruction | Ukrainian |
| Departmen | Прикладної гідроаеромеханіки і механотроніки |
| Teachers | Nyezhentsev Oleksiy |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Theoretical Mechanics", "Mechanics of Materials and Structures", "Theory of Mechanisms and Machines" |
| What will be studied | Beams with a moving load. Lines of influence of bearing reactions, bending moments and transverse forces in single-span, multi-span and cantilever beams. Selection of cross-sections and determination of the dimensions of composite beams. Calculation of traveling beams of cargo cranes. Calculation of sections of telescopic booms. Calculation of the farm. Determination of reactions, forces in truss rods using lines of influence from stationary and moving loads. Constructions, calculation and design of farms. Construction of influence lines of statically uncertain systems. Fundamentals of the dynamics of metal structures of lifting and transporting machines (LTM).<br>Materials of LTM metal structures. Calculations of strength by the methods of limit states and allowable stresses. Fatigue durability and survivability of LTM metal structures. Calculations and designing of welded, bolted and hinged joints in LTM metal structures. Cranes of the bridge type. Types of bridges and their main parameters. Calculated load combinations. Calculation of structures of gantry cranes, influence of spacer loads and distortions. Boom cranes. Types of crane booms, areas of their application and calculation. Constructions and calculations of crane towers. Constructions of portal cranes, their main parameters, calculations. Constructions of tower cranes, their basic parameters, calculations. |
| Why it is interesting / necessary to study | There are no such industrial enterprises, ports, railway stations, construction and other organizations that do not use LTM. Their reliability depends primarily on their metal structures. The main task of the discipline is for students to master the methods of calculating strength, rigidity and stability for the design of reliable and economical metal structures. To ensure the necessary reliability of the metal structure, its main elements must have sufficiently large cross-sectional areas, but the economy requires that the consumption of materials used in the manufacture of structures should be as low as possible. In order to find an acceptable compromise between the requirements of reliability and economy, basic knowledge of calculation methods and the principles of designing metal structures, taking into account the requirements of the LTM safety rules, is necessary. |
| What can be learned (learning outcomes) | Methods of determining forces and stresses in the elements of metal structures of LTM from stationary and moving loads.<br>The principles of designing LTM metal structures with minimal metal consumption while ensuring their reliability and durability.<br>Modern trends in the development of metal structures. |
| How to use the acquired knowledge and skills (competencies) | Determine the forces and stresses in the elements of metal structures from stationary and moving loads.<br>Perform calculations of LTM metal structures for strength, stability, deformability and fatigue life.<br>To design metal constructions of LTM with minimum metal consumption, ensuring their bearing capacity and convenient installation. |
| Information support | Educational and work programs of the discipline, syllabus, rating system of evaluation, lecture notes, textbooks and study guides (in the library of KPI named after I. Sikorskyi) methodical materials for laboratory classes |
| Form of classes | Lectures, laboratory works |
| Semester control | Test (written assessment work) |

## *Educational component 3.1*

| **Discipline** | **Fundamentals of electronics** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | 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. |
| Why you can learn (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) |

## *Educational component 3.2*

| Discipline | Gasdynamics |
|---|---|
| Course | 3, springtime semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Teacher | Volodymyr Turyk |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the subjects "Linear algebra and analytical geometry", "Higher mathematics", "General physics", "Theoretical mechanics", "Theoretical foundations of heat engineering", "Machine-building hydraulics". |
| What will be studied | Gas dynamics is a branch of mechanics that studies the high-speed movement of gas (steam, multiphase mixture) under conditions where the properties of the movement are affected by the compressibility of the substance. |
| Why is it interesting/should be studied? | The subject of study of the discipline: thermodynamic and acoustic characteristics of gas-dynamic processes; laws of conservation of mass, momentum, moment of momentum and energy; influence of gas compressibility on flow parameters; characteristic equations of isentropic flow; wave processes of small and strong disturbances; shock waves; normal and oblique shocks; one-dimensional theory of the Laval nozzle in calculation and non-calculation regimes; one-dimensional gas flow with friction; expendable, thermal, mechanical nozzle of supersonic speeds; interaction of compressible shocks with the boundary layer; flat and axisymmetric flow of compressible gas. |
| Why you can learn (learning outcomes) | Learning outcomes:: ability to independently formulate, analyze and solve problems of gas dynamics and to determine: space-time parameters fields of gas flows moving at high subsonic and supersonic speeds; conditions for the creation of such flows, their interaction with streamlined bodies and channel walls under given single-valuedness conditions; the ability to analytically, numerically or experimentally determine the parameters of high-speed flows, which makes it possible to create rational designs of objects of new technology without the danger of gas-dynamic or thermal blocking of flow parts of pneumatic systems, aircraft and rocket engines, channels of magneto-hydrodynamic systems, etc. |
| How to use acquired knowledge and skills (competencies) | Competencies: application of techniques and methods of gas dynamics for calculations, analysis of work and optimization of elements and structures of pneumatic systems, turbomachines, energy and technological installations, high-speed wind tunnels and equipment for physical research, including in the field of the latest technologies. |
| Occupation | Lectures, laboratory works, practical classes. |
| Information support | Textbooks, educational material, in particular, the available electronic edition (Turick V.M. "Fundamentals of gas dynamics"), packages of group laboratory work. |
| Individual semester assignments | Estimated work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Test (written Test) |

## *Educational component 3.3*

| **Discipline** | **Fundamentals theory of three-dimensional modeling** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Andrii Titov |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired while studying the disciplines "Informatics", "Engineering and computer graphics", "Basics of construction and design", "Industrial technologies and basics of engineering logistics" |
| What will be studied | General principles of modeling in Kompas-3D, SolidWorks, Catia. Typical three-dimensional elements. Creation of cross-sectional elements, kinematic elements, creation of 3D models based on flat drawings. Construction of parametric models. Creating assemblies. Creation of associative drawings. Additional modeling capabilities. |
| Why it is interesting / necessary to study | Computer systems of three-dimensional modeling are used in all modern enterprises to automate the technological processes of product design. The computer workshop provides an opportunity to easily master modern computer systems of three-dimensional modeling. |
| What you can learn (learning outcomes) | Knowledge of the main aspects of modern modeling methods, practical mastering of modern application programs of three-dimensional modeling with the aim of their further application to solve specific educational, research and production tasks. |
| How to use the acquired knowledge and skills (competencies) | To use three-dimensional modeling systems when designing various structures and their components, drawing up design documentation. |
| Information support | Study and work programs of the discipline, rating system, lecture notes (electronic edition), computer workshop (electronic edition) |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test (written test) |

## *Educational component 4.1*

| Discipline | Logical synthesis of control algorithms |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian, English |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksandr Gubarev, Oksana Ganpantsurova, 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.<br>Logical synthesis of control algorithms using algorithmic languages STL, LD, ST.<br>Consideration of the type of devices in control algorithms.<br>Memory elements, timers, counters and subroutines in control algorithms.<br>Assembly, testing and debugging of typical control algorithms for mechatronics systems.<br>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. |
| Why you can learn (learning outcomes) | Perform a logical synthesis of algorithms for the operation of typical cyclic systems of mechatronics<br>Conclude typical control algorithms for mechatronic systems based on algorithmic languages STL, LD, ST<br>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<br>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 |

## *Educational component 4.2*

| **Discipline** | **Compressor machines** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Konstantin Belikov |
| Requirements for the beginning of the study | Successful mastery of knowledge and skills acquired in the study of the disciplines "Volumetric hydraulic and pneumatic machines and hydraulic transmissions", " Machine-building hydraulics", "Theoretical mechanics", "Theory of mechanisms and machines", "Materials science", "Hydroaeromechanics and hydraulics", "Machine parts" |
| What will be studied | Principles of operation of compressor machines.<br>Classification of compressor machines.<br>Basics of calculation and design of compressor machines.<br>Structure and components of compressor stations. |
| Why it is interesting / necessary to study | Compressor machines are widely used in various industries as sources of pneumatic energy. Also, in the tasks of heat and mass transfer of air and gas mixtures, air conditioning, vacuum creation, etc. |
| Why you can learn (learning outcomes) | Design of the main components of compressor machines.<br>Calculation of the main parameters of compressor machines.<br>Analysis of characteristics. Determination of the efficiency of the compressor machine.<br>The procedure for preparatory and start-up work of compressor machines. Conducting tests. |
| How to use the acquired knowledge and skills (competencies) | Calculation and selection of the necessary compressor to power the pneumatic system. Design of parts and components of compressor machines. |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition), study guide (electronic edition) |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test (written test) |

## *Educational component 4.3*

| **Discipline** | **Fundamentals theory of automatic control** |
|---|---|
| Course | 3, spring semester |
| Volume | 4 ECTS credits (120 hours) |
| Language of study | Ukrainian |
| Department | Engineering technologies |
| Lecturers | Oleksandr Okhrimenko |
| Requirements for the beginning of the study | General natural science knowledge of mathematics and physics courses; Knowledge of disciplines studied in 1-2 courses: Higher Mathematics (Differential and Integral Analysis), Linear Algebra, General Physics, Theoretical Mechanics, Mechanics of Materials and Structures |
| What will be studied | General patterns of functioning inherent in automatic systems of different physical nature will be studied, and on the basis of these laws develops the principles of building high-quality control systems.. |
| Why it's interesting/should be studied | Automatic control theory is a section of cybernetics (technical cybernetics) that studies the ways of controlling various technical devices, technological processes and productions, regardless of the nature of their functioning. |
| What you can learn (learning outcomes) | The subject of study of the discipline are the theoretical foundations of automation. Includes basic data on terminology and the concept of automation. Local systems of automatic regulation and their tasks. Objects of automatic regulation. Structural and functional schemes of regulatory systems. Classification of systems. Stabilization, tracking, software, extreme systems. The principles of regulation by deviation, perturbation, combined, adaptive. Functional implementation schemes. Mathematical characteristics of automation elements. Differential equations, transfer functions, frequency characteristics. The concept of typical links of regulatory systems and their characteristics. Typical links. The concept of the object of regulation and the types of influences on it. Classification of objects and their dynamic characteristics. Acceleration curves, graphic processing of static and astatic objects of regulation. The concept of the regulator. Classification. Ideas about the laws of regulation. Dynamic characteristics of regulators and their analytical and graphic representation. Structural schemes of regulators. Formation of regulation laws. The concept of a transitional process in the SAR. Indicators of the quality of the transition process are dynamic and residual deviation, quadratic quality criterion, adjustment time. Typical transientent processes. Dynamic adjustment factor. The choice of the law of regulation. The concept of stability of regulatory systems. Criteria of stability and their verification. |
| How to use the acquired knowledge and skills (competence) | Thanks to automatic regulation, it is possible to achieve the goal of stabilizing various values of the regulated process, software control of output values, tracking any external factors and adapting them when considering the design of various mechanical machines or processes. |
| Classes | Lectures, laboratory, practical |
| Information support | Textbooks, tutorials, virtual laboratory work, individual tasks. https://classroom.google.com/c/MTUyMDIzODcyMjYx?cjc=6hibgv3 |
| Individual semester tasks | Home control work |
| Current control | Modular control work / execution and protection of laboratory results, express control, etc. |
| Semester control | Test |

## *Educational component 5.1*

| **Discipline** | **Electric hydraulic drive mechatronic systems** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Konstantin Belikov, Oksana Ganpantsurova |
| 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.<br>Design and principle of operation of elements of hydraulic systems.<br>Hydraulic systems for industrial purposes.<br>Electrical control of hydraulic system elements.<br>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. |
| Why you can learn (learning outcomes) | Fundamentals of hydraulic apparatus design.<br>Calculation and selection of power drives for hydraulic systems.<br>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) |

## *Educational component 5.2*

| **Discipline** | **Volumetric hydraulic drive** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Oksana Ganpantsurova |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired in the study of disciplines "Machine-building hydraulics", "Volumetric hydraulic and pneumatic machines and hydraulic transmissions", "Discrete control systems of actuators" |
| What will be studied | Development and construction of hydraulic schemes. Design of hydraulic apparatus structures, development of technical documentation. Calculation of design parameters of hydraulic devices and operating modes of hydraulic systems. Conducting practical studies of the performance characteristics of hydraulic devices and operating parameters of hydraulic systems. |
| Why it is interesting / necessary to study | Practical work with any hydraulic equipment (development or modernization of systems, maintenance, setting parameters, troubleshooting, etc.) requires basic knowledge of both the design features of individual hydraulic devices and the ability to create and read hydraulic diagrams. |
| Why you can learn (learning outcomes) | Basic principles of construction of hydraulic apparatus structures of drive systems. Methods of designing and modernization of efficient hydraulic drive control systems. Typical solutions of practical problems of calculation of systems and design of devices facing the engineer-developer of hydraulic drives. |
| How to use the acquired knowledge and skills (competencies) | Design and calculate the design of hydraulic devices, actuators and their components.<br>Develop design documentation for hydraulic drive systems.<br>Select modern element base of the system depending on the operating conditions of the drive.<br>Develop schemes of hydraulic hardware controls and electro-relay circuits and coordinate their interaction.<br>To assemble, adjust and diagnose hydraulic drive systems and put them into operation. |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition), study guide (electronic edition) |
| Form of classes | Lectures, laboratory classes |

## *Educational component 5.3*

| **Discipline** | **Hydraulic power drive of lifting and transport machines (LTM)** |
|---|---|
| Education system level | First (bachelor's) |
| Course | 3 |
| Amount | 4 ECTS credits |
| Language | Ukrainian |
| Department | Applied hydroaeromechanics and mechanotronics |
| Teachers | Dmytro Kostiuk |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired in the study of disciplines "Building Mechanics and Metal Structures LTM", "Mathematics", "Physics", "Theory of Machines and Mechanisms", "Machine Parts" |
| What will be studied | Basic principles of hydraulics and hydraulic drive, the principle of operation of hydraulic equipment used in the hydraulic drive of lifting and transport machines (LTM). Design and calculation of the main parameters of hydraulic drives of LTM.<br>Schematic solutions of hydraulic drives used in LTM<br>Features of hydraulic drives and their operation in the LTM. |
| Why it is interesting/necessary to study | Hydraulic drive is widely used in modern LTM. This is due to the many advantages of the hydraulic drive over other types of drives. The hydraulic drive is widely used in heavy-duty automated industrial lines, mobile construction equipment and works. Consider it, a modern qualified engineer must know the basic principles of operation of hydraulic drives and their application in the lifting and transport machines to obtain maximum efficiency of the equipment, be able to develop, maintain and work with systems equipped with hydraulic drive |
| What you can learn (learning outcomes) | The basic principles of hydraulics and to study the basic principles of operation of hydraulic drives, understanding and development of hydraulic schemes of LTM, the basic principles of equipment selection to ensure efficient and reliable operation of hydraulic drives |
| How to use the acquired knowledge and skills (competencies) | Design of hydraulic schematics and calculation of LTM hydraulic power drive basic parameters and characteristics. Maintenance and safety during work with the equipment. |
| Information support | Training and working programs of the discipline, RSO, lecture notes (electronic edition) |
| Form of classes | Lectures |
| Semester control | Test |

## *Educational component 6.1*

| **Course Title** | **Pneumaric actuators with electrical control** |
|---|---|
| Course Level | 3rd year |
| Amount | 4 credits ECTS |
| Language of teaching | Ukrainain |
| Chair | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleh Levchenko, Olexander Haletskiy |
| Prerequisites | 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 is it interesting/should be studied? | 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. |
| 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 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. |
| Classes | Lectures, laboratory classes, individual tasks |
| Information support | Educational and work programs of the discipline, RSE, lecture notes (electronic edition), study guide (electronic edition) |
| Individual semester tasks | Calculation and graphic work / Abstract / Analytical review |
| Current control | Modular control work, answers to practical / seminar classes, performance of laboratory work, express control, etc. |
| Semester control | Test (written evaluation test) |

## *Educational component 6.2*

| **Title** | **Pneumatic Actuators and Pneumatic Control Systems** |
|---|---|
| Curriculum | 3, spring semester |
| Circumference | 4 ECTS credits (120 hours) |
| Language | Ukrainian |
| Department | Department of applied hydroaeromechanics and mechatronics |
| Lecturer | Oleksandr Haletskyi |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Fluid and Gas Mechanics", "Discrete control systems of executive devices" |
| What will be studied | Basic pneumatic devices of the automation system; Structure and principle of operation of pneumatic valves with pneumatic and electropneumatic control; Electropneumatic converters, sensors and their characteristics. Construction of pneumatic control circuits. |
| Why it is interesting / should be studied | Modern production requires the training of specialists capable of solving complex tasks and problems in the field of applied mechanics using pneumatic control circuits and carrying out innovative professional activities. |
| Learning outcomes | As a result of mastering the discipline, knowledge is gained on the architecture of the structure of pneumatic systems and elements of automatic control of pneumatic systems; principles of building algorithms for controlling pneumatic automation devices with a combined version of control systems; use of modern methods of finding optimal solutions and rational parameters of technical devices; modern approaches, means and technical solutions for creating modern automatic systems with pneumatic actuators.<br>Acquired skills: apply techniques and methods of creating pneumatic automation systems in accordance with the requirements and features of the machine-building industry; use innovative technical solutions and approaches to the creation, design and modernization of pneumatic actuators as part of pneumatic automation systems.<br>Experience is gained: to choose and apply rational methods and technical means for solving specific tasks of automation in mechanical engineering; carry out an evaluation of the effectiveness of pneumatic automation systems with a pneumatic automatic control system; to make decisions for the rationalization of technical decisions when designing or modernizing automation objects, taking into account technical requirements and operational features. |
| How to use acquired knowledge and skills (competencies) | The ability to make informed decisions when designing pneumatic automation systems, critically analyze and forecast performance parameters of new and existing pneumatic actuators and pneumatic automation systems; the ability to develop control systems for pneumatic drives, to rationally approach the creation of new and modernization of existing control systems, to create competitive automation systems of technical objects and systems, to evaluate the effectiveness of existing, modernized or developed pneumatic automation systems. |
| Lesson | Lectures, laboratory, computer workshop |
| Information support | Synopsis of lectures, virtual laboratory works, Rating System of Evaluation |
| Individual semester assignments | Estimated work |
| Current control | Modular control work / implementation and protection of the results of laboratory work and computer workshops |
| Semester control | Assessment (written assessment) |

## *Educational component 6.3*

| **Discipline** | **Lifting machines** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Yurii Horbatenko, Andrii Petryshyn |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Construction mechanics and metal constructions of LTM", "Electrical engineering and electronics", "Theory of mechanisms and machines", "Mechanics of materials and structures", "Fundamentals of construction and design", "Industrial technologies and the basics of engineering logistics" |
| What will be studied | Designs and main layout schemes of lifting machines depending on production conditions. Theory and practical methods of calculations and design of mechanisms of lifting machines: lifting, moving, turning, braking, control systems, etc. |
| Why it is interesting / necessary to study | To create theoretical foundations and learn practical skills of researching the parameters and characteristics of mechanisms and machines in general; design and calculations of mechanisms, machines, their systems and complexes for the performance of predefined technological tasks, under certain operating conditions under specified load modes. |
| What you can learn (learning outcomes) | Perform analysis and comparative assessments of parameters and characteristics of mechanisms and machines that are presented on the market; perform calculations of kinematic and power parameters, in particular for transitional periods; perform working drawings of parts, assemblies, mechanisms and machines. |
| How to use the acquired knowledge and skills (competencies) | Carry out design and construction work of lifting equipment for machine-building, metallurgical, chemical and other branches of industry, carry out integration of lifting equipment into automatic production lines. |
| Information support | Study and work programs of the discipline, rating system, lecture notes (electronic edition), teaching manual for laboratory practice (electronic edition). |
| Form of classes | Lectures, practical classes. |
| Semester control | Test (written test) |

## *Educational component 7.1*

| **Discipline** | **Robots and manipulators in mechanical engineering** |
|---|---|
| Course | 1, spring semester |
| Amount | 4 ECTS credits ( 120 hours) |
| Language of teaching | Ukrainian |
| Chair | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Nochnichenko, Kostiantyn Belikov |
| Requirements for starting studies | 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 is it interesting/should be studied? | 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. |
| Why you can learn (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 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. |
| Occupation | Lectures, laboratory |
| Information support | Textbooks, study guides, virtual labs, packages of group labs |
| Individual semester tasks | Home control work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Assessment (written assessment) |

## *Educational component 7.2*

| **Discipline** | **Applied hydromechanics** |
|---|---|
| Course | 4, fall semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Fluid mechanics and mechatronics |
| Teachers | Oleg Yakhno, Dmytro Kostiuk |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the disciplines «Mechanics of liquid and gas ", "Gasodynamics", "Volume hydraulic and pneumatic machines and hydraulic transmissions", "Materials science" |
| What will be studied | Fundamentals of fluid mechanics and heat-mass exchange in processes occurring in mechatronics and hydraulic drive systems. In particular, for further application in such a field as aero-hydrodynamic schemes of ekranoplanes, studying the pulsation of hydro-aerodynamic loads on the rotor shaft of wind turbines, hydrodynamic models of various filter elements and much more. |
| Why is it interesting/should be studied? | The study of fluid and gas mechanics is the basis of fluid hydrodynamics, which makes it possible to obtain solutions in the development of hydroaerodynamics that are used in wind energy units, swimming units, flying units, submersible cavitators and others. |
| Why you can learn (learning outcomes) | The ability to study the theory of vortices is used to develop the dynamics of the atmosphere, the theory of an airplane wing, the theory of a propeller, a ship propeller, and a supercavitator during deep dives. |
| How to use acquired knowledge and skills (competencies) | Ability to study the basics of solid body mechanics, resistance of materials, technical hydromechanics and fluid and gas mechanics<br>To solve complex, unpredictable tasks and problems in specialized areas of professional activity and/or training, which involves the collection and interpretation of information (data), the selection of methods and tools, the use of innovative approaches.<br>Build information models of the subject of research: describe its essential parameters, input and variable values, establish cause-and-effect relationships between them. |
| Lesson (study) | Lectures, practical, laboratory |
| Information support | Study and work programs of the discipline, RS (rating system), lecture notes (electronic edition), study guide (electronic edition) |
| Individual semester assignments | Calculation work |
| Current control | Modular control work / implementation and protection of the results of laboratory and practical work, express control, etc |
| Semester control | Test |

## *Educational component 7.3*

| **Discipline** | **Robotics of logistics systems** |
|---|---|
| Course | 1, spring semester |
| Amount | 4 ECTS credits ( 120 hours) |
| Language of teaching | Ukrainian |
| Chair | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Nochnichenko, Oleh Levchenko |
| Requirements for starting studies | 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 | Design , development, construction, operation and use of robots, as well as computer systems for their control, sensor (based on the output signals of sensors) feedback and information processing of automated technical systems (robots). Types of robots and manipulators of logistics systems, schematic and constructive solutions, kinematic schemes of industrial robots, calculation of kinematics of industrial robots, basic algorithms and programs for programming robots. |
| Why is it interesting/should be studied? | The development of online trade and online services has increased the volume of work in the warehouse (formation of orders, inventory, control of shipments and receipts, monitoring of goods movement, delivery, etc.) so much that people are not able to cope with it, so the replacement of people with robots is unpredictable.<br>That is why we are witnessing explosive growth in the field of logistics automation and robotics. According to the research group ABI Research , by 2025 more than 4 million robots may work in global warehouses . |
| Why you can learn (learning outcomes) | Construction of mathematical models of robotics and logistics systems, taking into account modes and conditions of their operation. Gain knowledge and skills in the field of design, manufacturing and transportation of complex logistics systems. To study the methods of economic and mathematical modeling of logistics systems. |
| How to use acquired knowledge and skills (competencies) | Develop automated technical systems (robots) and create robotic complexes designed to automate complex technological processes, both from an economic point of view in terms of logistics, and to know the engineering component of logistics processes. |
| Occupation | Lectures, laboratory |
| Information support | Textbooks, study guides, virtual labs, packages of group labs |
| Individual semester tasks | Home control work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Assessment (written assessment) |

## *Educational component 8.1*

| **Discipline** | **Proportional hydraulics** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 3 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian, English |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Oksana Ganpantsurova, 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.<br>Types and principle of construction of structures of hydraulic devices with proportional control.<br>Performance characteristics and operating parameters of valves with proportional control.<br>Practical issues of application of drives with proportional control.<br>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. |
| Why you can learn (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.<br>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 |

## *Educational component 8.2*

| **Course Title** | **Mobile hydraulics** |
|---|---|
| Course Level | 4th year |
| Amount | 4 credits ECTS |
| Language of teaching | Ukrainian |
| Chair | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleh Levchenko, Oleksandr Haletskiy |
| Prerequisites | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Volumetric hydraulics", "Machine-building hydraulics", "Machine parts", "Fundamentals of construction and design". |
| What will be studied | Application directions of a mobile hydraulics. Open and closed hydraulic circuits. Hydrostatic transmissions, feed pumps, flushing units, bypass valves. Load sensitive hydraulic systems: open and closed center. Variable displacement pumps of mobile machines with manual and automatic regulators. Two-pump systems with relief valves. Flow dividers and summators. Sectional directional valves of mobile machines, 7/3 directional valves, differential pressure valves, anticavitation valves, shock valves, rollover valves. 6/3 open center directional valves: parallel, tandem and series connection. Schemes of load-independent flow control, pre-switched and post-switched. Holding and safe lowering of weight, controlled check valves, brake and balancing valves. Hydraulic and electronic joysticks. Priority valves, static and dynamic. Steering, with open and closed center, reactive and non-reactive. Specialized software for simulating the operation of hydraulic systems of mobile machines (FluidSim-Hydraulics 5.0). |
| Why is it interesting/should be studied? | The purpose of the lectures is to provide the basics of knowledge in the field of mobile hydraulics. |
| Learning outcomes | An important component in the training of mechanical engineers is also their acquisition of knowledge on the hydraulics of mobile machines. |
| How to use acquired knowledge and skills (competencies) | Assemble, debug and diagnose control systems of hydraulic drives of mobile machines. |
| Classes | Lectures, laboratory classes, individual tasks |
| Information support | Educational and work programs of the discipline, RSE, lecture notes (electronic edition), study guide (electronic edition) |
| Individual semester tasks | Calculation and graphic work / Abstract / Analytical review |
| Current control | Modular control work, answers to practical / seminar classes, performance of laboratory work, express control, etc. |
| Semester control | Test (written evaluation test) |

## *Educational component 8.3*

| **Discipline** | **Transport machines** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Yurii Horbatenko, Andrii Petryshyn |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Electrical engineering and electronics", "Fundamentals of automatic control theory", "Theory of mechanisms and machines", "Mechanics of materials and structures", "Fundamentals of construction and design", "Building mechanics and metal structures LTM", "Industrial technologies and basics of engineering logistics", "Forklifts", "Fundamentals of industrial electric drive" |
| What will be studied | Designs, principle of operation and purpose of typical machines and complexes for transporting goods and passengers. The specifics of the choice of transport vehicles depending on the type of cargo. Project calculation and types of control of transport machines. Characteristics and theory of cargo transportation: bulk, artificial, etc. |
| Why it is interesting / necessary to study | It is necessary to study in order to master the theory and gain practical skills from the basics of cargo transportation in both manufacturing and other industries. Gain experience in designing mechanisms and machines and their complexes with parameters that will ensure optimal performance and reliability of the cargo movement process under given conditions. |
| What you can learn (learning outcomes) | Carry out the design of transport equipment and its systems based on the analysis of production needs; to draw up basic structural and constructive diagrams of mechanisms, machines, their systems and complexes; perform calculations of traction and load-carrying bodies, drive stations; to develop algorithms for control systems of mechanisms and machines in order to automate the process of transporting goods. |
| How to use the acquired knowledge and skills (competencies) | To carry out design and construction and research developments in the field of mechanization and automation of loading and unloading and transportation operations in technological processes; to develop basic schemes of logistics systems with their necessary equipment. |
| Information support | Study and work programs of the discipline, rating system, lecture notes (electronic edition), study guide |
| Form of classes | Lectures, practical classes, individual assignments |
| Semester control | Test (written test) |

## *Educational component 9.1*

| **Discipline** | **Electrohydraulic automation of mechatronic systems** |
|---|---|
| Course | 4, fall semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Fluid mechanics and mechatronics |
| Teachers | Oleksandr Luhovskyi |
| Requirements for starting studies | 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 is it interesting/should be studied? | 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. |
| Why you can learn (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 acquired knowledge and skills (competencies) | Calculate and design hydraulic systems of automatic mechatronic control. Develop basic hydraulic schemes for automation systems.<br>Develop design documentation for mechatronic automatic control systems. Select a modern element base for mechatronic systems Automation. |
| Lesson (study) | Lectures, practical, laboratory |
| Information support | Textbooks, study guides, virtual laboratory work, packages of group laboratory work, packages of professional application programs |
| Individual semester assignments | Not provided for in the curriculum |
| Current control | Modular control work / implementation and protection of the results of laboratory and practical work, express control, etc |
| Semester control | Test |

## *Educational component 9.2*

| **Discipline** | **Machine-building hydraulic automation** |
|---|---|
| Course | 4, fall semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Fluid mechanics and mechatronics |
| Teachers | Oleksandr Luhovskyi, Andriy Zilinskyi |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the disciplines «Machine-building hydraulics», «Volume hydraulic and pneumatic machines and hydraulic transmissions», «Volume hydraulic drive», «Discrete control systems for actuators» |
| What will be studied | Acquaintance with control methods in cyclic automation systems. Acquaintance with the element base hydraulic logic devices of automation. Construction of schematic diagrams of logical blocks of cyclic automation systems. Peculiarities of programming cyclic systems and peculiarities of pumping units for cyclic automation systems. |
| Why is it interesting/should be studied? | In production, many technological processes require removal of a person from the process. At the same time, there are many cases of multiple repetition of technological operations. The problem can be solved by implementing cyclical automation systems with path control, pressure control or time control. |
| Why you can learn (learning outcomes) | You can learn the basic principles of building cyclic hydraulic automation systems with path control, pressure control, or time control. Learn the basic principles of building cyclic systems with logical control units. Understand the existing element base of hydraulic automation systems, understand the possibilities of programming cyclic systems. To deal with examples of the implementation of cyclic systems in industry, agriculture and medicine. |
| How to use acquired knowledge and skills (competencies) | Calculate and design cyclic systems of hydraulic automation. Develop basic hydraulic schemes for automation systems.<br>Develop design documentation for hydraulic drive systems of automatic systems.<br>Select a modern element base for automation systems.<br>Carry out assembly, debugging and diagnostics of hydraulic drive systems and put them into operation. |
| Lesson (study) | Lectures, practical, laboratory |
| Information support | Textbooks, study guides, virtual laboratory work, packages of group laboratory work, packages of professional application programs |
| Individual semester assignments | Not provided for in the curriculum |
| Current control | Modular control work / implementation and protection of the results of laboratory and practical work, express control, etc |
| Semester control | Test (written test) |

## *Educational component 9.3*

| **Discipline** | **Production and sales logistics** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Yurii Danylchenko, Andrii Petryshyn |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Industrial technologies and basics of engineering logistics", "Load-lifting machines", "Hydraulic drive of LTM" |
| What will be studied | Planning in production logistics, logistical principles of production organization, flow management at the production stage, transport and warehouse subsystem in production logistics, control and evaluation of the efficiency of production logistics.<br>Organization of the distribution system, distribution channels in industrial and consumer markets and the service market, inventory management in distribution channels. Organization of logistics service. |
| Why it is interesting / necessary to study | The main functional components of the logistics of an industrial enterprise that determine the effectiveness of its work on the market of goods and services are supply logistics, production logistics and distribution logistics (distribution). Coordination of the work of these components is the basis of minimizing costs of the enterprise's logistics system and quick response to changes in the market situation, which is the goal of the logistics strategy of industrial enterprises. |
| What you can learn (learning outcomes) | The practical implementation of the interaction of supply logistics, production logistics and distribution logistics aims to ensure the optimization or synchronization of the links of the production and logistics chains.<br>The learning outcomes are knowledge of logistic approaches to the organization of the production cycle, the organization of flow production on the basis of logistics, the creation of flexible production and logistics systems. |
| How to use the acquired knowledge and skills (competencies) | Planning of the need for material resources, management of material flows in production, operational and production planning of production, calculation of the optimal batch of production, drawing up a production schedule, location of equipment in the workshops of the enterprise in accordance with logistics requirements, assessment of the efficiency of production logistics, assessment of the efficiency of distribution channels and logistics service . |
| Information support | Educational and work programs of the discipline, rating system, lecture notes (electronic edition). |
| Form of classes | Lectures, laboratory classes |

## *Educational component 10.1*

| **Discipline** | **Mathematical modeling and design of physically heterogeneous systems** |
|---|---|
| Course | 4, autumn semester |
| Amount | 4 ECTS credits (120 hours) |
| Teaching language | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Lecturers | Oleksandr Uzunov, Oleksandr Galeckij, Igor Nochnichenko |
| Requirements for starting studies | 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 is it interesting/should be studied? | 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 you learn? (study results) | 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 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. |
| Activity type | Lectures, laboratory classes, independent work |
| Information support | Textbooks, study guides, virtual laboratory work, packages of group laboratory work, packages of professional application software. |
| Individual semester tasks | Calculation work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Test |

## *Educational component 10.2*

| **Discipline** | **Mathematical modeling and design of hydraulic and pneumatic drive systems** |
|---|---|
| Course | 4, autumn semester |
| Amount | 4 ECTS credits (120 hours) |
| Teaching language | Ukrainian |
| Department | Applied hydroaeromechanics and mechatronics |
| Lecturers | Oleksandr Uzunov, Oleksandr Galeckij, Igor Nochnichenko |
| Requirements for starting studies | 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 hydraulic and pneumatic drive systems and their distribution into typical functional components. Software tools for modeling processes. Forms of mathematical dependencies and peculiarities of building mathematical models of dynamic processes. The concept of the second generation simulation modeling. A library of typical elements for building models. Model testing and evaluation indicators of hydraulic and pneumatic drive systems. Analytical method for evaluating the work capacity and accuracy of systems in steady state. Formulation of the design problem of hydraulic and pneumatic drive systems 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 the hydro and pneumatic drive and determining its parameters that provide the predicted characteristics. |
| Why is it interesting/should be studied? | 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 you learn? (study results) | Understand the principles of operation and the structure of hydraulic and pneumatic drive systems. Understand the principles of dividing systems into typical elements and approaches to building mathematical models. Develop mathematical models to determine static and dynamic characteristics. Evaluate the influence of parameters on the characteristics of elements and systems. Design elements and systems. |
| How to use acquired knowledge and skills? (competencies) | Acquired knowledge and skills are used to develop mathematical models, modeling and designing elements and hydraulic and pneumatic drive systems. |
| Activity type | Lectures, laboratory classes, independent work |
| Information support | Textbooks, study guides, virtual laboratory work, packages of group laboratory work, packages of professional application software. |
| Individual semester tasks | Calculation work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Test |

## *Educational component 10.3*

| **Discipline** | **Transport and warehouse logistics** |
|---|---|
| Course | 4, autumn semester |
| Volume | 4 ECTS credits (120 hours) |
| Language of study | Ukrainian |
| Department | Applied hydroaeromechanics and mechanotronics |
| Lecturers | Andriy Petryshyn, Pavlo Protsenko |
| Requirements for the beginning of the study | Knowledge and skills in disciplines "Ukrainian language", "Higher mathematics", "Informatics", "Fundamentals of hydroautomatics", "Automated mechanical systems units design", "Fundamentals of industrial electric drive" |
| What will be studied | Principles of the modern transport logistics concepts. Objects of logistics management and logistics operations. Logistical approach to managing material flows in manufacturing and trade. Technology of material resources movement. Warehouse logistics. |
| Why it's interesting/should be studied | Logistics is the foundation of modern business. Logistics approaches in transportation and warehousing tend to increase efficiency and reduce the transportation cost. |
| What you can learn (learning outcomes) | Theory on the logistics concepts, strategies and tactics, as well as principles and laws of material flows movement and distribution.<br>Methods for the development and implementation transport and warehouse logistics.<br>Mastering the skills of logistics thinking and improving logistics systems and mechanisms for their functioning.<br>Skills in assessing economic efficiency and the consequences of implementing logistics decisions. |
| How to use the acquired knowledge and skills (competence) | Analysis, modeling and evaluation of logistics solutions.<br>Reengineering and optimization of business processes. Choosing a scenario for the development of company logistics.<br>Calculation of stock needs. Stock optimal level determination. Costs optimization for the stock maintenance.<br>Organization of purchases. Planning procurement operations. Supplier selection. Organization of interaction with the supplier.<br>Type of transportation selection. Optimal carrier selection. Transportation planning and organization. Logistics chains development for the various types of goods.<br>Warehouse design and organization of warehouse logistics. Numerical modeling of warehouse logistics and logistics of communal services. |
| Classes | Lectures, practical and laboratory work |
| Information support | Textbooks, manuals, virtual laboratory work, packages of group laboratory works, professional software |
| Individual semester tasks | Calculation and graphic work |
| Current control | Modular control work / execution and defence of laboratory results, |
| Semester control | Test |

## *Educational component 11.1*

| **Discipline** | **Computer modeling of mechatronics and robotics systems** |
|---|---|
| Course | 1, autumn semester |
| Amount | 4 ECTS credits ( 120 hours) |
| Language of teaching | Ukrainian |
| Chair | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Nochnichenko |
| Requirements for starting studies | 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 is it interesting/should be studied? | 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. |
| Why you can learn (learning outcomes) | Formation of mathematical models that make it possible to carry out physical and mathematical modeling;<br>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 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. |
| Occupation | Lectures, laboratory |
| Information support | Textbooks, study guides, virtual labs, packages of group labs |
| Individual semester tasks | Home control work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Assessment (written assessment) |

## *Educational component 11.2*

| **Discipline** | **Hydraulic and pneumatic turbomachines and transmissions** |
|---|---|
| Education system level | First (bachelor's) |
| Course | 4 |
| Amount | 4 ECTS credits |
| Language | Ukrainian |
| Department | Applied hydroaeromechanics and mechanotronics |
| Teachers | Dmytro Kostiuk |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired during the study of disciplines "Mechanical Engineering Hydraulics", "Gas Dynamics", "Mechanics of Materials and Structures", "Fundamentals of Mathematical Modeling of Physically Heterogeneous Systems", "Compressor Machines" |
| What will be studied | Design, the principle of operation and features of operation of hydraulic and pneumatic turbomachines. Fundamentals of design of structures of hydraulic and pneumatic turbomachines, Calculations of design parameters of hydraulic and pneumatic turbomachines. Carrying out practical research on hydraulic turbomachines. |
| Why it is interesting/necessary to study | Hydraulic and pneumatic turbomachines are widely used in almost all sectors of the industry. Practical work with any hydraulic equipment (development or modernization of systems, maintenance, adjustment of parameters, maintenance, troubleshooting, etc.) requires basic knowledge of both the design features of individual hydraulic devices and their work in the network and control of their characteristics. |
| What you can learn (learning outcomes) | Find out the principles of operation of hydraulic and pneumatic turbomachines and hydrokinetic transmissions. Develop design solutions and designs of hydraulic and pneumatic turbomachines, and hydraulic and pneumatic actuators. Carry out a design of systems of hydraulic and pneumatic actuators, and hydraulic and pneumatic turbomachines according to the set operational characteristics, modes and indicators. Find typical solutions to practical problems of calculation of systems and design of devices facing the engineer-developer of hydraulic drives |
| How to use the acquired knowledge and skills (competencies) | Design and calculate the design of hydraulic turbomachines. Develop design documentation for hydraulic equipment. Select equipment for the hydraulic system depending on the technical requirements.<br><br>Carry out assembly, adjustment and diagnostics of hydraulic drive systems and put them into operation |
| Information support | Curriculum and working programs of the discipline, RSO, lecture notes (electronic edition). |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test |

## *Educational component 11.3*

| **Discipline** | **Automated electric drive and basics of electric automation** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Vasyl Lukavenko, Andrii Zilinskyi |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired during the study of disciplines: "Mathematics", "Physics", "Forklifts", "Fundamentals of automatic control theory", "Informatics", "Electronics and electrical engineering". |
| What will be studied | Principles of operation, structure of motors: alternating current and direct current, their mechanical and electromechanical characteristics, starting methods, speed regulation, switching schemes, static and dynamic characteristics and modes of operation. Features of the structure and regulation of asynchronous motors with a short-circuit as the most common, and a phase rotor. Braking: electric, generator with energy return to the network, anti-circuit, dynamic. Frequency converters and their application as modern devices for effective control of an asynchronous electric drive. Features of stepper and linear motors and operating principles of control circuits. Electric drive systems of elevators, their design features and control schemes. Tracking electric drive. Servo drive. Methods and means, analog and digital devices, hardware and software devices for performing experimental research. |
| Why it is interesting / necessary to study | The goal of the educational discipline is the formation of students: basic knowledge about the components, structure, principle of operation and functioning of direct and alternating current AED; basics of design and operation of electric drives of technological objects, which combine the power electric part, mechanical transmission device, electronic control unit. After studying the course, students demonstrate knowledge of: the physical essence of analytical dependencies in relation to AC and DC electric machines; mechanical and electromechanical characteristics of electric motors and understanding the essence of electromagnetic and energy processes occurring in AC and DC electric drives. |
| What you can learn (learning outcomes) | The study of the discipline ensures the availability of the necessary knowledge for competent operation and the initial skills of analysis and modernization of AED control schemes based on modern achievements; performing diagnostics of the electric drive and restoring its efficiency; use of measuring devices and signal conversion devices for measuring electrical and mechanical quantities; |
| How to use the acquired knowledge and skills (competencies) | Solve practical tasks of creating and operating AED. To carry out experimental studies of the operation of AED using modern computer technologies, which is facilitated by the implementation of the cycle of laboratory works on the experimental study of AED, provided by the educational program. |
| Information support | Study and work programs of the discipline, rating system, lecture notes (electronic edition), teaching manual for laboratory practice (electronic edition). |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test (written test) |

***Educational component 12.1***

| **Discipline** | **Computer design of mechatronics and robotics modules** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | 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. |
| Why you can learn (learning outcomes) | Creation of parametric sketches.<br>Creating solid parts in a variety of ways.<br>Work with complex surfaces.<br>Work with a sheet body.<br>Creation of assembly units taking into account the constraints imposed on the component.<br>Creating working drawings from previously developed 3D components.<br>Work with specialized applications for creating pipelines. |
| How to use the acquired knowledge and skills (competencies) | The acquired skills allow you to fully express yourself as a design engineer.<br>This course is aimed at developing engineering thinking with the integrated application of previously acquired knowledge in various subjects.<br>The complexity of the work is expressed in the independent development of the course project. |
| Information support | Study and work programs of the discipline, rating grading system, lecture notes (electronic edition) |
| Form of classes | Lectures, practical exercises, independent work.<br>Individual task - calculation and graphic work. |
| Semester control | Test (written test) |

## *Educational component 12.2*

| **Discipline** | **Designing of hydraulic and pneumatic drives** |
|---|---|
| Course | 4, spring semester |
| Volume | 4 ECTS credits (120 hours) |
| The language of instruction is | Ukrainian |
| Department | of Applied Hydroaeromechanics and Mechatronics |
| The teacher is | Serhii Nosko |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Applied hydromechanics", "Machine-building hydraulic automation", Mathematical modeling and design of hydraulic and pneumatic drive systems", "Volume hydraulic and pneumatic machines and hydraulic transmissions", "Pneumatic drive and pneumatic automation". |
| What will be studied | Development and construction of hydropneumatic schemes. Element base for building automated hydropneumatic systems (main types of drives, guiding and regulating equipment,control and measuring devices, logic and calculationapparatus). Calculation of static and dynamic parameters of hydropneumatic drives. Design methods of hydraulic and pneumatic drives and practical development of control algorithms Development of technical documentation |
| Why is it interesting/should be studied? | Practical work with any hydropneumatic equipment (development or modernization of systems, maintenance, setting parameters, identifying and eliminating problems, etc.) requires basic knowledge of both the structural features of individual hydraulic devices, as well as the ability to design hydraulic and pneumatic drives. This allows you to relatively quickly change the amount of equipment involved, adapting the system to changes in production tasks, which is one of the modern trends in the development or modernization of automated hydropneumatic drives |
| Why you can learn (learning outcomes) | Basic principles of construction and calculation of hydropneumatic drives. Methods of design and modernization of effective operational performance control systems of hydraulic and pneumatic drives. Typical solutions to practical system calculation and design problems faced by the engineer-developer of hydraulic and pneumatic drives.<br>Modern approaches, tools and technical solutions for building hydropneumatic automated systems using pneumatic and hydraulic automation tools. |
| How to use acquired knowledge and skills (competencies) | Ability to use modern design methodologies of hydraulic and pneumatic actuators, control and control devices, and hydraulic and pneumatic machines. Ability to design control systems for hydraulic and pneumatic actuators.<br>The ability to present the results of one's engineering activities in compliance with generally accepted norms and standards |
| Occupation | Lectures, practical, independent work. |
| Information support | Textbooks, study and work programs of disciplines, RSO, lecture notes (electronic edition), study guide (electronic edition), packages of individual tasks. |
| Individual semester assignments | Home control work |
| Current control | Modular control work / implementation and protection of the results of practical classes, express control, etc |
| Semester control | Assessment (written) |

## *Educational component 12.3*

| **Discipline** | **Technology and logistics of automated production** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Yurii Danylchenko, Andrii Petryshyn |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Robotics of logistics systems", "Technology of construction materials", "Industrial technologies and basics of engineering logistics", "Load-lifting machines", "Transport and warehouse logistics", "Production and sales logistics" » |
| What will be studied | The main directions of production automation and ways of increasing its productivity and efficiency. Features of automated production technology. Automation of the main and auxiliary operations of technological processes of mechanical processing. Automation of transport and warehouse operations of machining production. Logistic support of automated production. |
| Why it is interesting / necessary to study | Modern mechanical engineering is focused on the creation of "unmanned factories" ("Lights-Out" Manufacturing) based on the wide implementation of complex production and transport logistics systems. Successful implementation of this task requires future specialists to understand the technological and logistical support of such production and knowledge and skills in the application of modern technical means and methods of organization and management of end-to-end material flows in production. |
| What you can learn (learning outcomes) | Basic principles of choosing directions and means of production automation. Methods of evaluating the productivity of various options for automating production processes. Approaches to the development of structural schemes and planning of automatic lines, flexible production systems (FPS) and automated transport and storage systems (ATSS). |
| How to use the acquired knowledge and skills (competencies) | Develop schematic solutions and evaluate various options for automating production processes. Select means of automation and logistic equipment of automatic lines, FPS ATSS. Develop structural diagrams and planning of automatic lines, FPS and ATSS. |
| Information support | Educational and work programs of the discipline, rating system, lecture notes (electronic edition). |
| Form of classes | Lectures, practical classes, individual assignments |
| Semester control | Test (written test) |

## *Educational component 13.1*

| **Discipline** | **Innovative devices of mechatronics** |
|---|---|
| Course | 4, spring semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Fluid mechanics and mechatronics |
| Teachers | Oleksandr Luhovskyi, Andriy Zilinskyi |
| Requirements for starting studies | 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 is it interesting/should be studied? | 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. |
| Why you can learn (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 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. |
| Lesson (study) | Lectures, practical, laboratory |
| Information support | Study and work programs of the discipline, RS (rating system), lecture notes (electronic edition), study guide (electronic edition) |
| Individual semester assignments | Calculation and graphic work |
| Current control | Modular control work / implementation and protection of the results of laboratory and practical work, express control, etc |
| Semester control | Test |

## *Educational component 13.2*

| **Discipline** | **Computational hydromechanics of hydraulic components** |
|---|---|
| Education system level | First (bachelor's) |
| Course | 4 |
| Amount | 4 ECTS credits |
| Language | Ukrainian |
| Department | Applied hydroaeromechanics and mechanotronics |
| Teachers | Serhii Nosko |
| Requirements for the beginning of the study | Successful mastering of knowledge and skills acquired in the study of disciplines “Informatics”, “Fundamentals of design and engineering”, “Applied hydromechanics”, “Gas dynamics”, “Mathematical modelling and design of systems of hydraulic and pneumatic actuators”, “Hydraulic and pneumatic turbomachines and transmissions” |
| What will be studied | General information about computer modelling systems for hydromechanical, thermal and mass transfer processes, basics of hydromechanical process modelling, review of basic software packages used to solve computer hydromechanical problems, features of 2D and 3D models construction, types of boundaries and boundary conditions, features creating of the mesh, monitoring of the calculation, conditions for stopping the calculation, visualization and analysis of the obtained data. |
| Why it is interesting/necessary to study | Nowadays, computer modelling is widely used in the study of hydrodynamic processes and the development and modernization of equipment. Increasing the availability of computing and modelling makes it possible in many cases to replace expensive and time-consuming, and in some cases impossible, real experiments for computational hydrodynamics (CFD) research. Tasks of this type are found in almost all fields of engineering from the calculation of ventilation systems to the research of state-of-art airplanes. Therefore, modern engineers and scientists need knowledge in this field |
| What you can learn (learning outcomes) | The basic principles of construction of models of computer hydromechanics in specialized software packages, rational choice of model for the decision of the set task, carrying out the analysis of the received results |
| How to use the acquired knowledge and skills (competencies) | Create models of hydraulic and pneumatic drive components, model liquid or gas flows in devices of hydraulic and pneumatic systems, such as valves, pumps, etc., and determine the main characteristics of the observed flow. |
| Information support | Curriculum and working programs of the discipline, RSO, lecture notes (electronic edition). |
| Form of classes | Lectures, laboratory classes, individual tasks |
| Semester control | Test |

## *Educational component 13.3*

| **Discipline** | **Introduction to mechatronics** |
|---|---|
| Course | 4, spring semester |
| Amount | 4 ECTS credits (120 hours) |
| Language of teaching | Ukrainian |
| Department | Fluid mechanics and mechatronics |
| Teachers | Alona Murashchenko |
| Requirements for starting studies | Successful mastering of the knowledge and skills acquired during the study of the disciplines: «Discrete control systems for actuators», «Informatics», «Robotics of logistics systems", "Automated electric drive and basics of electric automation" |
| What will be studied | The principle of creating automated control of production processes using controller programming. Examples of the use of mechatronics in various industries based on the study of programs used in automated processes.<br>Programming of automation links of production processes and technical facilities using computer programs. |
| Why is it interesting/should be studied? | Mechanotronics is widely used from modern industry to control systems in residential buildings. The study of programming algorithms makes it possible to solve problems of automation by any process that can be implemented without human physical labor. |
| Why you can learn (learning outcomes) | Ability to use basic ideas about the variety of approaches and means of creating control systems for any production process.<br>Ability to develop control systems for hydraulic and pneumatic actuators based on freely programmable controllers used in the management of production processes.<br>Methods of increasing production efficiency due to the use of programmable control controllers for automation. |
| How to use acquired knowledge and skills (competencies) | Solve practical tasks of automation of technical objects by writing the algorithm of the control program of various systems and practically check the correctness of their writing on educational stands, modular stands, which are production process automation lines.<br>The ability to increase the degree and quality of automation of existing facilities through modernization and reengineering of hydropneumatic automation systems, optimization of work modes and composition, use of innovative technical solutions and approaches |
| Lesson (study) | Lectures, practical, laboratory |
| Information support | Study and work programs of the discipline, RS (rating system), lecture notes (electronic edition), study guide (electronic edition) |
| Individual semester assignments | calculation and graphic work |
| Current control | Modular control work / implementation and protection of the results of laboratory and practical work, express control, etc |
| Semester control | Test |

## *Educational component 14.1*

| **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 |
| Departmen | 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. |
| Why you can learn (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) |

## *Educational component 14.2*

| **Discipline** | **Testing and diagnostics of drive systems** |
|---|---|
| Course | 1, spring semester |
| Amount | 4 ECTS credits ( 120 hours) |
| Language of teaching | Ukrainian |
| Chair | Applied hydroaeromechanics and mechatronics |
| Teachers | Ihor Nochnichenko |
| Requirements for starting studies | 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 | The main concepts and types of testing and diagnosis of the main malfunctions of technical physically diverse systems, electro -pneumatic position drives, electro -hydraulic systems. The main equations characterizing the reliability and causes of failure of drive system units. Analysis of reliability indicators and determination of statistical characteristics of drives, determination of drive reliability at the design stage, prediction of drive reliability, maintenance and repair. |
| Why is it interesting/should be studied? | Testing and research must be carried out in any technical systems, both during development and operation. The ability to master the skills of testing and diagnostics allows you to develop and carry out regular maintenance of hydraulic and pneumatic devices and systems. Also check and evaluate the technical condition of hydropneumatic equipment, organize preventive control and repair with replacement of modules. |
| Why you can learn (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 acquired knowledge and skills (competencies) | According to the existing methods and algorithms, with a known scheme, to organize installation, commissioning and experimental testing of hydropneumatic equipment and systems. Develop and carry out regular maintenance of hydraulic and pneumatic devices and systems, carry out inspections and evaluate the technical condition of hydropneumatic equipment. Organize preventive control and repair with replacement of modules. Modernize the existing hydraulic and pneumatic systems under known operating conditions, load, speed, consumption of working fluid. |
| Occupation | Lectures, laboratory |
| Information support | Textbooks, study guides, virtual labs, packages of group labs |
| Individual semester tasks | Home control work |
| Current control | Modular control work / implementation and protection of the results of laboratory work, express control, etc |
| Semester control | Assessment (written assessment) |

## *Educational component 14.3*

| **Discipline** | **Operation and maintenance of lifting and transport machines** |
|---|---|
| Educational level | First (bachelor's) |
| Course | 4 |
| ECTS Credits | 4 ECTS credits |
| Language of instruction | Ukrainian |
| Departmen | Applied hydroaeromechanics and mechatronics |
| Teachers | Oleksii Niezhentsev |
| Requirements for the beginning of the study | Successful mastering of the knowledge and skills acquired during the study of the disciplines "Construction mechanics and metal constructions of LTM", "Automated electric drive and basics of electric automation", "Industrial technologies and basics of engineering logistics", "Forklifts", "Transport and warehouse logistics" |
| What will be studied | Installation of lifting and transporting machines (LTM). Rigging equipment, mounting devices and equipment (ropes, slings, sleepers, grabs, block clamps, hoists, winches, jacks, mounting masts, sheaves, portals, mounting cranes, anchors, support platforms). Production of rigging and installation works. Calculation and testing of rigging means. Installation of lifting machines (overhead, gantry, tower and portal cranes, hoists). Installation of continuous transport machines (belt and chain conveyors, bucket elevators). Operation and repair of LTM. LTM maintenance and repair system. Friction and wear in LTM nodes. Types and properties of lubricants, lubrication methods and systems. Technological process and main operations of LTM repair. Malfunctions of typical LTM parts and ways to restore them. Repair of parts and assembly units of LTM. |
| Why it is interesting / necessary to study | There are no industrial enterprises where LTMs are not used. In order to fully implement the technical capabilities inherent in the design of machines, to ensure high productivity in work with strict compliance with the rules of safety and operation of LTM, it is necessary to master the knowledge, abilities and skills necessary for solving the tasks of increasing the reliability of LTM, creating and implementing progressive technologies for their installation, operation and repair. |
| What you can learn (learning outcomes) | Methods of production of rigging and assembly works. Conducting calculations and testing rigging means. Methods of installation of lifting machines (bridge, gantry, tower and portal cranes, elevators) and machines of continuous transport (belt and chain conveyors, bucket elevators). Principles of operation, maintenance and repair of LTM. Methods of increasing wear resistance and reducing the harmful effect of wear on the work of LTM. Methods of repair of parts and assembly units of LTM. |
| How to use the acquired knowledge and skills (competencies) | To ensure trouble-free and reliable operation during the operation of LTM. Perform calculations and tests of rigging equipment. Analyze the causes of failure of machine parts and assemblies. Make a list of defects and make defections of parts, determine the causes of failure of mechanisms and metal structures of LTM. Determine the repairability of parts, taking into account the methods of restoring worn surfaces, propose ways to eliminate defects, and assign equipment and tools. Choose rational methods of carrying out repair work, order spare parts, assemblies, lubricants taking into account their needs, compile repair information, operational schedules, calculate the need for spare parts, lubricants, tools and devices. |
| Information support | Study and work programs of the discipline, rating system, lecture notes, methodical instructions for laboratory classes |
| Form of classes | Lectures, laboratory classes |
| Semester control | Test (written test) |