



## Silhouette of the educational component

Programme of the discipline



Навчально-науковий інститут  
механічної інженерії і транспорту

# Hydraulic equipment for mechatronic systems

### Code and name of the speciality

131 - Applied mechanics

### Institute

Educational and Research Institute of Mechanical Engineering and Transport (MIT)

### Educational programme

Applied mechanics

### Department

parts Machine hydraulic pneumatic systems  
(148)

### Level of education

Master

### Type of discipline

Selective

### Semester

3

### Language of instruction

Ukrainian

## Teachers, developers



### Mariana Stryzhak

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D. in Engineering, Associate Professor, Associate Professor of the Department of Machine Parts and Hydropneumatic Systems of NTU "KhPI"

Author of more than 60 scientific and educational publications. Leading lecturer in the courses: "Theory of Automatic Control and Dynamics of Mechatronic Systems", "Modern Element Base of Mechatronic Systems", "Volumetric Hydraulic Machines", "Fundamentals of Calculation and Design of Electro-Hydraulic and Electro-Pneumatic Transducers", "Fundamentals of Scientific Research".

[More about the lecturer on the department's website](#)

## General information

### Abstracts.

The discipline is devoted to the study of the principles of operation, control and monitoring of hydraulic and pneumatic drive with proportional control in operational and production facilities in various industries, design of systems and devices and modernisation of hydraulic and pneumatic drive with proportional control of automated mechatronic facilities.

### Purpose and objectives of the discipline

Developing students' abilities:

- to solve complex practical problems of automation of technical objects by creating hydraulic and pneumatic drive systems in combination with hydraulic automation and robotics for technical objects for various purposes;
- design structures, calculate and adjust the operating parameters of hydraulic and pneumatic devices with proportional control and hydraulic and pneumatic drives based on them.

### Class format

Lectures, laboratory classes, essay. The final control is an exam.

## Competences

GC5. Ability to use information, communication and digital technologies.

GC7. Ability to apply knowledge in practical situations.

GC8. Knowledge and understanding of the subject area and understanding of professional activities.

SC3. Ability to make an optimal choice of technological equipment, tools, technical complexes, have a basic understanding of the rules of their operation.

SC4. Ability to use computer-aided design systems (CAD, CAM, CAE) and specialised application software to solve technological problems in applied mechanics.

SC6. Ability to describe and classify technical objects and processes based on knowledge and understanding of basic mechanical theories and practices, as well as basic knowledge of related sciences.

SC7. Ability to apply appropriate quantitative mathematical, technical methods and computer software to solve typical professional problems of applied mechanics.

## Learning outcomes

ELO2. Use knowledge of the theoretical foundations of electrical engineering, electronics and related sciences to solve professional problems;

PO4. Use application software to perform technological calculations, process information and research results;

PO5. To know the design, methods of selection and calculation, basics of maintenance and operation of drives of machine tools and robotic equipment;

PO6. Understand the principle of operation of automated control systems for technological equipment, in particular microprocessor-based, be able to select and use the best means of automation, automation of production processes.

## Scope of the discipline

The total volume of the discipline 120 hours (4 ECTS credits): lectures - 32 hours, practical classes - 16 hours, independent work - 72 hours.

## Prerequisites for studying the discipline (prerequisites)

To successfully complete the course, you must have knowledge and practical skills in the following areas disciplines: "Fundamentals of Informatics", "Calculations and Modelling of Hydropneumatic Systems", "Hydraulics", "Fundamentals of Hydraulic Drive Theory", "Modern Element Base of Mechatronic Systems".

## Features of the discipline, teaching methods and technologies

Lectures are conducted interactively with the use of multimedia technologies, and laboratory classes are held in the laboratory of the Department of Machine Parts and Hydropneumatic Systems. Teaching materials are available to students via Microsoft Teams.

## Programme of the discipline

### Topics of lecture classes

Topic 1. Introduction. Course objectives. History of development. Areas of application of systems with proportional control devices.

Topic 2. Design, purpose and principle of operation of proportional control pressure valves.

Topic 3. Design, purpose and principle of operation of proportional chokes and flow valves.

Topic 4. Design, purpose and principle of operation of proportional control distributors.

Topic 5. Performance characteristics of proportional control valves.

Topic 6. Dynamic parameters of valves. Examples of typical circuit solutions using proportional control valves.

Topic 7. Control electronics of mechatronic systems of hydraulic automation. Block diagram of the electrical part of mechatronic systems. Types of adjustable electromagnets.

Topic 8: Control electronics for proportional valves. Elements of electrical circuits. Amplifying cards for proportional valves.

Topic 9: The concept of a servo drive. Areas of application of servo drives.

Topic 10. Design and principle of operation of hydraulic servo drives. Hydraulic amplifier of the first stage of the servo valve. Types of feedback.

Topic 11: Requirements for filtration of working fluids of hydraulic systems with proportional devices.

Topic 12: Examples of industrial equipment using mechatronic devices.

## Topics of practical classes

### Topics of laboratory work

Topic 1: Pneumatic loading module.

Topic 2. Pneumatic fixation module.

Topic 3. Hydraulic lift module.

Topic 4. Hydraulic conveyor module.

Topic 5. Multiposition hydraulic manipulator module.

Topic 6. Hydraulic drive module with variable speed control.

Topic 7. Pneumatic press drive module with two pressure levels.

Topic 8: Hydraulic drive module with proportional speed control.

Topic 9: Hydraulic press drive module with proportional force control.

### Independent work

The course involves writing an essay on an individual topic. The result is presented in the form of a Power Point presentation.

## Literature and training materials

1. Scholz D. Proportional hydraulics. Basic course: Textbook.- SE "FESTO".- Kyiv.- 2002.- 123p.
2. Functional modules of mechatronics systems with pneumatic, electromechanical and hydraulic actuators [Electronic resource]: textbook / O.P. Hubarev, O.S. Hanpanturova, K.O. Belikov, A.M. Murashchenko; Igor Sikorsky Kyiv Polytechnic Institute.
3. Yakhno O.M. et al. Applied hydroaeromechanics and mechatronics / Edited by Yakhno O.M. - Vinnytsia: VNTU, 2019.- 711 p.
4. Proportional Hydraulics. Workbook Basic Level/ D. Scholz, A. Zimmermann, Festo Didactic GmbH&Co, OCKER Ingenieurbüro, Denkendorf 1998, 352 S.
5. Hydraulic means of automation: Basic course/Translation into Russian, ed: "Festo Didactic KG, D-7300, Esslingen, 1988, 410 pp.
6. Ebel F., von Terzi M. Festo Didactic. Mechatronics: Festo Didactic GmbH&Co., D73770 Denkendorf, 2000.- 108 S.
7. Elektrohydraulik: elektrische Steuerungen für Hydraulik.- Ruksaldruck, Berlin: Beuth.-1990.-90 S.
8. Mechatronika/ pod kier. Dietmara Schmida.- Polish edition REA, Warszawa.- 2002.- 384p.
9. Mobilhydraulik und Elektronik. Mannesmann Rexroth.- Bonitas-Bauer.- Würzburg.-1992.-416 S.
10. Proportional Hydraulics. Workbook Basic Level/ D. Scholz, A. Zimmermann, Festo Didactic GmbH&Co, OCKER Ingenieurbüro, Denkendorf 1998, 352 S.
11. Proportional- und Servoventil-Technik Der Hydraulik Trainer Band 2/ R. Ewald, J. Hutter, D. Kretz, A. Schmitt, Mannesmann Rexroth GmbH, Lohr am Main, Würzburg 1998, 304 S.

## Evaluation system

### Criteria for assessing student performance and distribution of points

100% of the final grade consists of assessment results in the form of a test (40%) and ongoing assessment (60%).

Assessment: written assignment (2 questions from theory + problem solving) and an oral presentation.  
Current assessment: calculation task (40% each).

### Rating scale

Total points	National assessment	ECTS
90-100	Excellent	A
82-89	Good.	B
75-81	Good.	C
64-74	Satisfactory	D
60-63	Satisfactory	E
35-59	Unsatisfactory (further study required)	FX
1-34	Unsatisfactory (re-study required)	F

## Standards of academic ethics and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": show discipline, good manners, goodwill, honesty, responsibility. Conflict situations should be openly discussed in study groups with the teacher, and if it is impossible to resolve the conflict, they should be brought to the attention of the staff of the Institute's directorate.

Regulatory and legal support for the implementation of the principles of academic integrity of NTU "KhPI" is available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

## Approval

Silabus has been approved

29.03.2023p.

Head of the Department  
Anatoliy Gaidamaka

Date of approval, signature

Guarantor of the OP  
Alexander PERMYAKOV