COURSE DESCRIPTION CARD - SYLLABUS

Course name

Proportional drive systems

Course

Field of study

Mechanical engineering

Area of study (specialization)

-

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3/6

Profile of study

general academic

Course offered in

polish

Requirements

elective

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

0

Projects/seminars

0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Faculty of Mechanical Engineering

Piotrowo 3, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

KNOWLEDGE: The student has basic knowledge in the field of hydraulics and pneumatics, automatics, mechanics and electrical engineering.

SKILLS: The student is able to solve basic problems in the field of fluid mechanics, the basics of machine construction and electrically controlled fluid switching systems.

SOCIAL COMPETENCIES: The student understands the need to expand their competences and the readiness to cooperate as part of the team.

Course objective

Getting to know the structure and principles of operation of hydraulic and pneumatic proportional and servo drive systems. Examples of the use of systems in transport, mobile and technological devices. Mastering the skills of basic design calculations and the principles of selecting drive components.

Course-related learning outcomes

Knowledge

Has an ordered, theoretically founded knowledge of technical mechanics and fluid mechanics, which allows to calculate: force systems, equilibrium of plane and spatial systems; determine support values; analyze: the statics of beams, columns, frames and trusses; describe: elements of the theory of the state of stress and strain, linear-elastic systems; calculate allowable stresses; describe: strain hypotheses, efforts of machine elements, elements of kinematics and dynamics of a material point, system of material points and a rigid body, elements of fracture mechanics, problems of fluid statics and kinematics, Bernoulli's equations, laminar and turbulent flow, flows through closed and open channels, Navier equations -Stokes, similarities of flow phenomena, resistance forces of flowing bodies, potential flow and gas dynamics. Has ordered, theoretically founded general knowledge in the field of vibrations of mechanical systems. Basic knowledge of computational methods in mechanics, fluid mechanics and strength (FEM and other methods). K_W03

Has detailed knowledge of machines and technological devices, including conventional and numerically controlled (OSN), universal and general-purpose machine tools, construction and principles of operation, drives (main, feed and auxiliary) of technological machines, typical elements of machines and technological devices, development trends: machine tools for machining, electro-erosion, electrochemical and abrasive blasting, machines and devices for casting, machines and devices for metal forming, machines for plastics processing, devices for heat and thermo-chemical treatment, welding, CNC machines, knows the issues of diagnostics machines at various stages of the life of technical systems and machine operation. Has knowledge of the vibroacoustics of machines and devices, vibroacoustic diagnostics of machines and devices, knows the principles of ergonomics, knows the principles of hydraulics, including the basics of fluid technology. K_W07

Has knowledge in the field of electrical engineering and electronics, covering issues used in the design and analysis of electric drive systems and machine control systems. K_W12

Skills

He is able to design and implement a simple device, object, system or process, typical for mechanical engineering, in accordance with the given specification, using appropriate methods, techniques and tools. K_U16

He can design and analyze electric drive systems and machine control systems. K_U18

Can use automation and automatic regulation systems in technology, use the basics of PLC programming, select sensors, assemble elements and measuring systems in automation, design control systems for machines and production processes, select electric drives of machines, select robots for tasks in machine construction, program basic educational and industrial works. K_U19

Social competences

Understands the need for lifelong learning; can inspire and organize the learning process of other people. K_K01

Can interact and work in a group, assuming different roles in it. K_K03

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: pass on the basis of a written exam or online test.

Laboratory: credit on the basis of practical assembly and design tasks.

Programme content

-Lecture:

Lecture 1 - General information about proportional hydraulics.

Construction and operation of a hydrostatic drive with the use of proportional valves and servo valves. Advantages, disadvantages, application.

Lecture 2 - Control methods for hydraulic proportional and servo drives - part 1

Control and regulation of position, speed and force of hydraulic actuators with the use of proportional valves and servo valves - part 1

Lecture 3 - Control methods for hydraulic proportional and servo drives - part 2

Control and regulation of position, speed and force of hydraulic actuators with the use of proportional valves and servo valves - part 2.

Lecture 4 - Basics of calculating proportional hydrostatic systems.

Methods of basic calculations of the drive - selection of actuators, setting, power and control elements. Simulation programs.

Lecture 5 - General information about proportional technique in pneumatic systems.

Construction and operation of a pneumatic drive with the use of proportional valves. Advantages, disadvantages, application.

Lecture 6 - Methods of controlling and regulating pneumatic proportional systems.

Control and regulation of position, speed and force of pneumatic actuators with the use of proportional valves.

Lecture 7 - Selection of elements of the pneumatic proportional system.

Examples of the selection of actuators, setting, power and control elements. Support and simulation programs.

Lecture 8 - Machines and devices using the technique of proportional drives and servo drives.

Examples of machines and devices that use hydraulic and pneumatic proportional systems and electro-hydraulic servo drives. Position and speed control and regulation systems in working and technological machines. Braking systems.

Laboratories:

Laboratory 1 - Organizational classes. Presentation of computer simulation programs.

Overview of the regulations in force in the laboratory, issuing teaching materials for classes. Presentation of programs for simulating proportional fluid systems.

Laboratory 2 - Simulation of proportional fluid systems using the FluidSIM software.

Learning to use FluidSIM computer programs as a tool for simulation and testing of hydraulic and pneumatic proportional and servo systems.

Laboratory 3 - Designing control systems for hydraulic proportional drives using the FluidSIM software package.

Design tasks for hydraulic proportional and servo drives using the FluidSIM software.

Laboratory 4 - Assembly and testing of hydraulic proportional drives - part 1.

Assembly tasks of hydraulic proportional and servo drives using specialized assembly stations - part 1.

Laboratory 5 - Assembly and testing of hydraulic proportional drives - part 2.

Assembly tasks of hydraulic proportional and servo drives using specialized assembly stations - part 2.

Laboratory 6 - Testing the response of an electrohydraulic servo drive.

Discussion of the construction and principles of operation of an electrohydraulic vibration exciter as an example of an electrohydraulic servo drive. System dynamics study.

Laboratory 7 - Assembly and testing of pneumatic proportional drives.

Installation tasks of pneumatic proportional drives using a specialized assembly station.

Laboratory 8 - Programming of a pneumatic positioning drive.

Learning to use and program a two-axis pneumatic positioning manipulator.

Teaching methods

1. Lecture: Lecture with multimedia presentation.

2. Laboratory: Practical classes with the use of specialized assembly stations and simulation software.

Bibliography

Basic

1. Ewald R., Hutter J., Kretz D., Liedhegener F., Schenkel W., Schmitt A., Reik M. Der Hydraulik Trainer Band 2, Proportional und Servoventil-Technik. Mannesmann Rexroth 1998.

2. Milecki A., Liniowe serwonapędy elektrohydrauliczne. Modelowanie i sterowanie. WPP, Poznań 2003.

3. Szydelski Z. Pojazdy samochodowe – napęd i sterowanie hydrauliczne. WKŁ, Warszawa 1999.

4. Świder J. (red.): Sterowanie i automatyzacja procesów technologicznych i układów mechatronicznych, Wydawnictwo Politechniki Śląskiej, Gliwice, 2002.

Additional

1. Świder J., Wszołek G.: Metodyczny zbiór zadań laboratoryjnych i projektowych ze sterowania procesami technologicznymi, Wydawnictwo Politechniki Śląskiej, Gliwice, 2003.

2. Szenajch W.: Napęd i sterowanie pneumatyczne. WNT, Warszawa, 2003.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	40	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	35	1,5

[1] delete or add other activities as appropriate