COURSE DESCRIPTION CARD - SYLLABUS

Course name
Construction of machines and industrial equipment [N1Mech2>BMiUP]

Course

Field of study
Mechatronics

Year/Semester
4/8

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
8

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

Lecturers

Prerequisites

Knowledge: He/She has knowledge in the field of basic machine construction, technical drawing, and the use of computer-aided design (CAD) tools. He/She possesses well-organized, theoretically grounded general knowledge in technical mechanics and material strength. Skills: He/She can apply analytical, simulation, and experimental methods to formulate and solve engineering tasks. He/She is skilled in formulating problems and using engineering methods in the analysis of technical issues. He/She can gather information from the Internet, libraries, reading rooms, and other resources. Specifically, he/she can correctly identify sources of necessary information. He/She is able to assess the quality and relevance of the information and data found. Additionally, he/she is skilled in integrating information from various resources, interpreting it, drawing conclusions, and formulating and justifying opinions. Social Competencies: He/She can collaborate and work effectively in a team, taking on various roles within the group.

Course objective

The aim of the course is to provide detailed knowledge about the construction of: drive systems in industrial machines, transport devices, manipulators, and working systems in industrial machines, considering a broad classification of these machines. The discussed topics will be supplemented with a presentation of the functioning of previously discussed components in machines and devices implemented into industry by the Institute of Machine Construction, whose solutions have also been protected by intellectual property rights. A perfect complement to the information delivered in the lectures will be the laboratory sessions, during which students will construct selected functional assemblies of machines and devices from real components, thereby consolidating the knowledge gained, while also developing their imagination, awareness as design engineers, and manual skills.

Course-related learning outcomes

Knowledge:
He/She has knowledge in mechatronics, including the definition and origin of the term "mechatronics," the construction of mechatronic devices and their functional description, sensors, actuators, controllers, and the interchangeability and replaceability of components. He/She is also familiar with examples of technical solutions for mechatronic devices. This knowledge enables him/her to describe and understand the essence of operation and construction of mechatronic systems.
He/She has knowledge in engineering design of machines and devices, covering the theory of machines and mechanisms, tribology, machine joints, drives, shafts and axles, clutches and brakes, mechanical transmissions, methods for kinematic system analysis, basic hydrostatic drives, machine design algorithms, selection of machine components based on strength and durability criteria, engineering databases for machine construction, technical standards, and best practices applied in engineering and technologies. The acquired knowledge enables him/her to design mechanical machines and devices, objects, processes, and systems from a systems perspective.
He/She has detailed knowledge of the design of mechatronic devices, particularly regarding the description and modeling of their individual elements, and the relationships between mechanical, electrical, fluid, and control subassemblies that form a single device. He/She has general knowledge about patents, copyright law, related rights, and personal data protection.

Skills:
He/She is able to design "mechatronically," meaning integrating mechanical, electronic, sensor, actuator, and microprocessor controller elements into a single device. He/She can also recognize system-level and non-technical aspects during the design process.
He/She is capable of critically analyzing the functioning of a mechatronic device and evaluating existing technical solutions in this field.
He/She can select and assess the suitability of a drive system for a mechatronic device.

Social competences:
He/She understands the need for lifelong learning and is able to inspire and organize the learning process for others.
He/She is aware of the importance and understanding of non-technical aspects and consequences of engineering activities, including their impact on the environment and the responsibility associated with the decisions made.
He/She can collaborate and work effectively in a team, taking on various roles within the group.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: The assessment consists of a written exam with answers to the posed questions.
Each question can earn a maximum of 1 point. Achieving at least 50% of the total points from all questions is required to pass the exam.
Laboratory: The assessment is conditional on completing all laboratory exercises along with reports for each of them. Each report must be accepted and positively evaluated by the instructor.

Programme content

Classification of machines and devices, drive systems of machines and devices, working systems in machines and devices, manipulators, design process, hydraulic and pneumatic systems, simulation.

Course topics

Lecture:
Lecture 1 - Classification of Industrial Machines and Devices
This lecture covers a comprehensive classification of technical machines and devices, along with their application areas.
Lecture 2 - Drive Systems in Industrial Machines
The content of this lecture involves detailed discussion on the construction of components and assemblies used in modern industrial machines and devices. Topics include positioning systems with ball screws, the geometric features of ball screws, bearing processing, and selection, as well as drive systems using toothed belts, and the structure and properties of the components involved.
Lecture 3 - Transport Devices
This lecture discusses the construction and application areas of industrial transport devices, such as conveyor belts, AGV (Automated Guided Vehicles) carts, manipulators, etc.
Lecture 4 - Manipulators and Their End Effectors in Industrial Machines and Devices
This lecture covers the kinematic structures of manipulators and the construction of their end effectors, used in machines and devices performing specific functions in the production process, with references to concrete examples.
Lecture 5 - Working Systems in Industrial Machines and Devices
The lecture discusses the construction and issues related to designing working components used in industrial machines and devices that perform specific functions such as cutting, bending, perforating, drilling, pick-and-place tasks, etc.
Lecture 6 - Analysis of the Impact of Design Process Stages on Functional Features of Machines or Devices
This lecture addresses errors that can occur at each stage of the design process and their impact on the functioning of the machine or device, based on examples of implemented machines and devices developed by the Institute of Machine Construction.
Lecture 7 - Machine Design Process on the Example of a Glue Spraying Device
The lecture covers all stages of the design process (from setting output data to project criteria to launching the device in a production facility) of a glue spraying device.
Lecture 8 - Knowledge Assessment through Written Exam
In the assessment, students will be asked to provide written answers to posed questions.
Laboratories:
Laboratory 1 - Introductory Session
This session introduces the tasks students will undertake during the course, explains the content of each exercise, and outlines the requirements for passing this part of the course. The group will be divided into teams for the laboratory exercises, which will take place at specific lab stations.
Laboratory 2 - Machine Parts
Students will perform manual tasks involving the assembly and disassembly of a single-stage reduction gearbox.
Laboratory 3 - Design of a Positioning System Using a Ball Screw
Students will design a drive system using a ball screw, utilizing a virtual environment. They will then verify the design by building the system from specified components and assemblies, and testing it in real life.
Laboratory 4 - Design of a Positioning System Using a Toothed Belt
Students will design a drive system using a toothed belt, using a virtual environment, and later verify the design by building and testing the system in real life.
Laboratory 5 - Design of a Conveyor Belt
Students will design a conveyor belt using a virtual environment. They will then verify the design by building and testing it with real components.
Laboratory 6 - Design of a Cartesian Coordinate Manipulator with Electric Drive
Students will design a manipulator with a Cartesian coordinate workspace using a virtual environment. They will verify the design by building and testing the manipulator with real components.
Laboratory 7 - Design of a Serial Kinematic Chain Manipulator (O-O-O) with Electro-Pneumatic Drive
Students will design a manipulator with a serial kinematic chain (O-O-O) using a virtual environment. The design will be verified by building and testing the manipulator with real components.
Laboratories 8-15
Simulation and testing of hydraulic and pneumatic systems using specialized software programs.

Teaching methods

Lecture: Informational lecture, conversational lecture
Laboratory: Project-based method, workshop-based method

Bibliography

Basic:
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3. Uhl T., Projektowanie mechatroniczne : zagadnienia wybrane : praca zbiorowa pod red., Wydawnictwo Instytutu Technologii Eksploatacji, 2006
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5. Oleksiuk W., Paprocki K., Konstrukcja mechanicznych zespołów sprzętu elektronicznego, WKŁ, Warszwa 1997
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9. Markowski M., Przenośniki cz.2, Wydawnictwo Politechniki Łódzkiej wyd.3 Łódź 1999

Additional:
1. Hinzen H., Basiswissen Machinenelemente 2, de Gruyter Oldenbourg 2014
2. Hinzen H., Machinenelemente 2, de Gruyter Oldenbourg 2014
3. Dietrich M., Podstawy budowy maszyn cz. 1, Wydawnictwo PW 1984
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5. Biały W., Maszynoznawstwo. WNT, Warszawa 2006
6. Kijewski J., Miller A., Pawlicki K., Maszynoznawstwo, WSiP

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	24	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	51	2,00