COURSE DESCRIPTION CARD - SYLLABUS

Course name

Designing prototypes and test stands

Course

Field of study

Mechatronics

Year/Semester

1/2

Area of study (specialization)

Mechatronic design of machines and vehicles

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

15

Laboratory classes

Other (e.g. online)

Tutorials

Projects/seminars

30

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Phone: + 48 61-665 2244

Responsible for the course/lecturer:

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Prerequisites

Knowledge: Basic knowledge of mathematics, materials science, mechanics, basics of machine construction, theory of machines and mechanisms, strength of materials, automation and robotics acquired during the 1st degree studies.

Skills: The ability to independently formulate a technical problem, develop a construction record in accordance with the rules of a technical drawing, calculate the strength of machine components, shape the design features of machine components, formulate control algorithms, identify parameters of technological processes.

Social competences: Understanding the need to expand one's competences, readiness to cooperate as part of a team.

Course objective

The aim of the course is to familiarize the student with the methodology of conducting research and development works, developing research methods, conducting research, developing research results and drawing conclusions.

Course-related learning outcomes

Knowledge

Has an extended knowledge of the strength of materials related to the safety and reliability of mechanical structures, calculation of composite elements, frames and curved bars as well as thin-walled tanks and thick-walled vessels. Has knowledge of the basics of optimal structure design. [K2_W03]

Has knowledge of computer structure analysis including advanced operations in the CAD environment, regarding 3D visualization and analysis of the cooperation of mechanical elements. [K2_W15]

He has in-depth knowledge of the automation of devices and production processes, in particular including programming of advanced control functions in a PLC controller, rules of connecting controllers into an industrial network, e.g. PROFIBUS, MODBUS, programmatic network operation and information exchange, ensuring the security of automated systems. Has knowledge of visualizing the work of automated systems, in particular using the InTouch environment. [K2_W12]

Ma poszerzoną wiedzę z mechatroniki o znajomość analizy i projektowania złożonych systemów mechatronicznych, teorii i techniki systemów oraz o zastosowania modelowania i symulacji w projektowaniu mechatronicznym. [K2_W09]

Skills

He can visualize a mechanical element in a 3D environment and analyze the cooperation of elements shown in the drawing. [K2_U19]

He can perform strength calculations allowing to determine the safety and reliability of selected mechanical structures. Is able to determine the strength of basic composite elements, frames and curved bars as well as thin-walled tanks and thick-walled vessels. [K2_U09]

Can design complex mechatronic devices and systems, using modeling and simulations. He can plan and carry out experiments, including measurements and computer simulations, interpret the obtained results and draw conclusions. [K2_U14]

He can use computer systems to design and operate mechatronic devices. He can implement control systems in the real-time operating system. He can use the basic methods of image processing and analysis. He can prepare software documentation. [K2_U15]

Social competences

Understands the need for lifelong learning; can inspire and organize the learning process of other people. [K2_K01]

Can set priorities for the implementation of a task set by himself or others. [K2_K04]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written credit of the lecture containing a few open theoretical questions. Duration: 90 minutes. Assessment criteria: 1 point is foreseen for each task, points are awarded with an accuracy of 0.25 points, there is a total of 5 points to score. Rating scale: below 50% - 2.0, from 50% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.

Project: Designing a prototype of a selected device or test stand. Assessment criteria: Defending the prototype design of the selected device or test stand. 1 point to get. with an accuracy of 0.1 points. Rating scale: below 50% - 2.0, from 50% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.

Programme content

Lectures:

Lecture 1 - From idea to industry.

Presentation of the stages of the design process and product production, paying particular attention to the place of prototypes and test stands in this process.

Lecture 2 - Iterative design process

Presentation of the issues of iteration in the design process, searching for a set of correct and optimal solutions.

Lecture 3 - Prototyping

Presentation of the prototyping process as an effective visual analytical tool confirming the needs and requirements of the user through iterative design development

Lecture 4 - Types of prototypes

Functional prototype, pre-production prototype, functional prototype.

Lecture 5 - The essence of the research stand in the design process

Presentation of the test stand as an indispensable tool for identifying the parameters of technological processes that are the input data for the design process at a specific stage.

Lecture 6 - Methodology and guidelines for designing research stands

Presentation of the problems of designing research stands with an indication of the differences in meeting the general and specific principles of designing utility devices and test stands.

Lecture 7 - Designing test stands on the basis of examples

Presentation of selected research stands, paying particular attention to their design features.

Lecture 8 - Assessment

Written credit from the lecture containing a few open theoretical questions

Projects:

Project 1 - Guidelines for the design of a prototype of a selected device or test stand

Project 2 - Selection of tools supporting the design process: Inventor, Solid Works, Abaqus, etc.

Project 3 - Implementation of an individual prototype project / test stand

Project 4 - Baseline data, defining functional characteristics

Project 5 - 3D modeling part. 1.

Project 6 - 3D modeling part. 2.

Project 7 - 3D modeling part. 3.

Project 8 - Kinematic analyzes part 1.

Project 9 - Kinematic analyzes part 2.

Project 10 - FEM strength analyzes, part 1.

Project 11 - FEM strength analyzes, part 2.

Project 12 - FEM strength analyzes, part 3.

Project 13 - Technical documentation, part 1.

Project 14 - Technical documentation, part 2.

Project 15 - Project defense

Teaching methods

Lecture: Lecture with multimedia presentation.

Projects: Workshop methods of practical computer classes.

Bibliography

Basic

1. Paweł Pyrzanowski, Metody eksperymentalne w mechanice i budowie maszyn, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2018

2. Wiesław Leszek, Wybrane zagadnienia metodyczne badań empirycznych, Instytut Technologii Eksploatacji - Państwowy Instytut Badawczy, Radom, 2006.

3. Jan A. Wajand, Zarys problematyki badań naukowych w technice, Wydawnictwo Akademii Techniczno-Humanistycznej, Bielsko-Biała, 2009

4. Tadeusz Uhl, Projektowanie mechatroniczne: zagadnienia wybrane: praca zbiorowa, Instytut Technologii Eksploatacji - Państwowy Instytut Badawczy, Radom, 2014

Additional

1.Wojtkowiak D., Talaśka K., Fierek A.: The application of the Finite Element Method analysis in the process of designing the punching die for belt perforation, IOP Conferences: Materials Science and Engineering 776: 012057, 2020.

2. Wojtkowiak D., Talaśka K., Wilczyński D. i inni: Determining the Power Consumption of the Automatic Device for Belt Perforation Based on the Dynamic Model, Energies 14:1, 317, 1-15, 2021.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for project classes, preparation for exam, project preparation) [1]	30	1,0

[1] delete or add other activities as appropriate