COURSE DESCRIPTION CARD - SYLLABUS

Course name

Methodology of conducting research and development works

Course

Field of study

Mechatronics

Year/Semester

1/1

Area of study (specialization)

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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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.

Laboratory: Assessment in the form of verification of practical skills in conducting research work. Ongoing verification of acquired skills during laboratory exercises. Credit is given on the basis of a report prepared on the conducted research.

Assessment criteria: the report on the research, presentation of research results, statistical analysis and inference is subject to evaluation. For each report, you can get 1 point 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 - The essence and concept of knowledge (science) and methodology

Elements of the knowledge system, division of science, general, detailed, descriptive and normative methodology.

Lecture 2 - The concept, essence and principles of scientific research

Objectives and functions of scientific research. Research tasks. Principles of the process of scientific cognition. Analysis and synthesis. Comparing and contrasting. Generalization and inference. Types of research.

Lecture 3 - The essence and conditions of research problems

Research and scientific problem. Theses, hypotheses and their importance in scientific research.

Lecture 4 - Research methods

Observational and experimental method, computer simulation, analysis and criticism of literature sources.

Lecture 5 - Organization and stages of research and development research

Activities in the process of solving research problems. Formulating and justifying the research problem. Selection of methods, techniques and research tools. Research with the use of patent databases.

Lecture 6 - The essence and concept of measurement in scientific research

Types of measurements, measurement errors, measurement reliability, statistical processing of measurement results.

Lecture 7 - Development of the research procedure

Conducting research, organizing research results, their control and analysis, presentation of research results.

Lecture 8 - Assessment

Written credit from the lecture containing a few open theoretical questions

Laboratories:

Laboratory 1 - Development of the test procedure, taking measurements, processing the results, inference - buckling of a slender element.

Laboratory 2 - Development of the test procedure, taking measurements, processing the results, inference - deformation of the flexible element.

Laboratory 3 - Development of the test procedure, taking measurements, processing the results, inference - the tightening torque of the bolt connection

Laboratory 4 - Development of the test procedure, execution of measurements, preparation of results, inference - critical speed of the shaft

Laboratory 5 - Development of the test procedure, taking measurements, processing the results, inference - positioning accuracy of the selected actuator.

Laboratory 6 - Development of the test procedure, performance of FEM computer simulation, development of results, inference - stiffness of the selected structural element.

Laboratory 7 - Development of a research procedure, computer simulation - kinematic analysis, preparation of results, inference - operation of the selected mechanism.

Laboratory 8 - Pass

Completion of the laboratory in the form of verification of practical skills in developing a research procedure, carrying out research, developing research results, drawing conclusions.

Teaching methods

Lecture: Lecture with multimedia presentation.

Laboratory: Workshop methods of practical laboratory and computer classes

Bibliography

Basic

1. Czesław Cempel, Nowoczesne zagadnienia metodologii i filozofii badań: wybrane zagadnienia dla studiów magisterskich, podyplomowych i doktoranckich: poradnik, Instytut Technologii Eksploatacji, Radom, 2005

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

3. Jerzy Apanowicz, Metodologia ogólna, Gdynia 2002.

4. Jan Kosmol, Wybrane zagadnienia metodologii badań, Wydawnictwo Politechniki Śląskiej, Gliwice, 2010.

Additional

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

2. 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.

3. 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	50	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests/exam) [1]	20	1,0

[1] delete or add other activities as appropriate