COURSE DESCRIPTION CARD - SYLLABUS

Course name
Automatic handling systems

Course

Field of study
Mechatronics
Area of study (specialization)
Mechatronic design of machines and vehicles
Level of study
Second-cycle studies
Form of study
full-time

Year/Semester
1/2
Profile of study
general academic
Course offered in
Polish
Requirements
elective

Number of hours

Lecture
15
Laboratory classes
Other (e.g. online)
Tutorials
Projects/seminars
15

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Faculty of Mechanical Engineering

Piotrowo Street 3, 61-138 Poznań

Responsible for the course/lecturer:
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Faculty of Mechanical Engineering

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Prerequisites

Knowledge: Has knowledge of the basics of machine construction, technical drawing and the

application and use of computer-aided design tools. Has ordered, theoretically founded general knowledge of technical mechanics and strength of materials.

Skills: Can use analytical, simulation and experimental methods to formulate and solve engineering tasks. He can formulate problems, use engineering methods in the analysis of technical issues.

He can obtain information from the Internet, library and reading room and other resources. In particular, he can correctly indicate the sources of the necessary information. He can define the quality and usefulness of the information and data found. He can also integrate information obtained from various resources, interpret them, as well as draw conclusions and formulate and justify opinions.

Social competences: Can interact and work in a group, assuming different roles in it.

Course objective

The aim of the course is to provide detailed knowledge on the construction of parts and assemblies of automatic handling systems. These include AGVs (Automated Guided Vehicles), automatic warehouses, pick and place manipulators, vibratory feeders and overhead cranes. Design classes are to be a perfect complement to the information provided during the lecture, during which students are to design selected devices in groups, thus priming the acquired knowledge, while developing the imagination, awareness of the design engineer and manual skills.

Course-related learning outcomes

Knowledge

He has an extended knowledge of the strength of materials regarding 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 extended knowledge of control, including description of impulse and nonlinear systems, Z transform, impulse and nonlinear control, linearization methods and stability studies of impulse and nonlinear systems. Has a basic knowledge of the selection of control elements of impulse and nonlinear systems [K2_W05].

Has knowledge of technical mechanics on the theory of collisions, analytical mechanics, the use of constraints, generalized coordinates, Dirichlet's principle, vibrations of systems with many degrees of freedom, nonlinear vibrations, motion trajectory in phase space and elements of chaos theory [K2_W06].

Has extended knowledge of mechatronics, knowledge of the analysis and design of complex mechatronic systems, systems theory and technology, and the application of modeling and simulation in mechatronic design [K2_W09].

Skills

Can obtain information from the Internet, literature, databases and other properly selected sources (mainly in English or another foreign language recognized as the language of international

communication) in the field of mechatronics; is able to integrate the obtained information, interpret it, as well as draw conclusions and formulate and justify opinions [K2_U01].

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].

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

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

Social competences

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

Can interact and work in a group, assuming different roles in it [K2_K03].

He can think and act in a creative and entrepreneurial way [K2_K06].

Correctly identifies and resolves dilemmas related to the profession [K2_K05]. 3. Can think and act in a creative and entrepreneurial way- [K2_K06].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written test in the form of answers to the questions posed.

A maximum of 1 point can be obtained for each question. Achieving a minimum score of 50% on all questions will be a condition for obtaining a pass.

Project: getting credit for the completion of the project set in the first class along with its presentation in the last class.

Programme content

Lecture:

Lecture 1 - Classification of handling machinery and equipment

The content of the lecture covers the presentation and discussion of the full classification of machines and devices for the implementation of the activities of transporting elements and assemblies from point A to point B, together with an indication of the areas of their application. The lectures will cover standards and regulations related to devices of this type.

Lecture 2 - AGV (Automated Guided Vehicles) construction

The content of the lecture covers the principles of operation and the detailed construction of elements of the units and assemblies that make up the construction of the AGV, together with the basic design calculations for the construction process of this type of device. The content of the lecture also covers the structure of the AGV control system and its types.

Lecture 3 - Construction of automated warehouses

The content of the lecture covers the principles of operation and the detailed construction of elements of assemblies and assemblies that make up the construction of automatic warehouses, together with a discussion of the basic design calculations for the construction of components of this type of device.

Lecture 4 - Construction of manipulators for pick and place activities

The content of the lecture covers the discussion of kinematic structures along with the construction of manipulators for handling and discussion of the structure of their end effectors with simultaneous reference to specific examples.

Lecture 5 - Construction of vibratory feeders

The content of the lecture covers the structure and problems of constructing vibratory feeders for the delivery of an element from the container to the working system of the machine with a simultaneous initial orientation of this element.

Lecture 6 - Construction of gantries /

The content of the lecture covers the construction and problems of constructing overhead cranes.

Lecture 7 - Invited lecture

The lecture is conducted by an invited specialist from the industry, who will present an interesting solution / design solutions for selected / selected devices used to perform handling activities.

Lecture 8 - Assessment

As part of the credit, students will be asked to answer the questions in writing.

Projects:

Design classes 1 - Introductory classes

During the course, students will be divided into subgroups and each of them will receive a project topic to be implemented during the course.

Design classes 2

The content of the course covers the methodology of calculating the elements and assemblies that make up the construction of the AGV together with the selection of the above-mentioned.

Design classes 3

The content of the course includes a discussion of the methodology of calculating elements and assemblies that make up the construction of automatic warehouses together with the selection of the above-mentioned.

Design classes 4

The content of the course covers the methodology of calculating elements and assemblies that make up the construction of manipulators for handling transport, together with the selection of the above-mentioned elements and assemblies.

Design classes 5

The content of the course covers the methodology of calculating elements and assemblies that make up the construction of vibratory feeders together with the selection of the above-mentioned elements and assemblies.

Design classes 6

The content of the course covers the methodology of calculating elements and assemblies that make up the construction of overhead cranes along with the selection of the above-mentioned elements and assemblies.

Design classes 7

Consultation classes with each project group.

Design classes 8

Presentation of the completed project (max. 10 min), each group.

Teaching methods

Lecture: information lecture, seminar lecture

Design classes: project method, demonstration

Bibliography

Basic

1. Konopka St., Sprawka P., Maszyny i urządzenia transportu bliskiego i przeładunkowego, Warszawa, Wojskowa Akademia Techniczna, 2008

2. Yi Yang, Wei Pan, Automated guided vehicles in modular integrated construction: potentials and future directions, Construction Innovation Vol. 21 No. 1, 2021 pp. 85-104

3. Raczyk R., Środki transportu bliskiego i magazynowania, Wyd. 2 popr. i rozsz. – Poznań, 2013

4. Sclater N., Chironis N.P., Mechanisms and mechanical devices, Mc Graw Hill Companies 2007

5. Uhl T., Projektowanie mechatroniczne : zagadnienia wybrane : praca zbiorowa pod red., Wydawnictwo Instytutu Technologii Eksploatacji, 2006

6. Oleksiuk W., Paprocki K., Konstrukcja mechanicznych zespołów sprzętu elektronicznego, WKŁ, Warszwa 1997

7. Furmanik K.: Transport przenośnikowy. UWND Kraków 2008

8. 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

4. Dietrich M., Podstawy budowy maszyn cz. 2, Wydawnictwo PW 1985

5. Biały W., Maszynoznawstwo. WNT, Warszawa 2006

6. Kijewski J., Miller A., Pawlicki K., Maszynoznawstwo, WSiP

7. Ceccarelli M., Fundamentals of Mechanics of Robotic Manipulation, Springer-Science+Business Media, B.V. 2004

8. Pahl G., Beitz W., Feldhusen J., Grote K.H., Engineering Design, Springer 2007

9. Bolton W., Mechatronics : a multidisciplinary approach, Pearson/Prentice Hall, 2008.

10. Heimann B., Gerth W., Popp K., Mechatronik : Komponenten, Methoden, Beispiele, Fachbuchverlag Leipzig im Carl Hanser Verlag, 1998

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 project classes, preparation for exam, project preparation) [1]	20	1,0

[1] delete or add other activities as appropriate