COURSE DESCRIPTION CARD - SYLLABUS

Course name
Design of automatic guided vehicles and mobile robots [S1MiBM2>PWiRM]

Course

Field of study
Mechanical Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

Lecturers

Prerequisites

The student has basic knowledge of mechanics, electrical engineering, automation, basics of machine design and structured theoretical knowledge in the field of study. The student has basic knowledge about electric drives and drive transmission methods. Is able to use literature (obtaining knowledge from indicated sources) and the Internet.

Course objective

Acquiring knowledge about the structure and principles of operation of automatic and autonomous AGV/ AMR transport systems used in in-plant transport. Learning about solutions regarding mobile robots (AMR/ AGV) and automatic logistics trains. Familiarizing students with various kinematic systems of bogies and towed trailers coupled to them. Acquiring knowledge about the basic components of systems such as: propulsion system, control system, navigation and safety system. Showing the differences between an automatic and autonomous system. Presentation of safety analysis for an automatic and autonomous system. Acquiring the ability to design the mechanical component of a self- propelled AGV trolley or an AMR mobile robot for specific boundary conditions.

Course-related learning outcomes

Knowledge:
The student has knowledge of the basic solutions used in industry regarding automatic and autonomous

production logistics systems. The student knows what components such solutions consist of. Knows the basic kinematic systems used in AGVs, AMR mobile robots and towed trailers and understands the capabilities of each solution. Knows how to program mobile robots. Knows the limitations of current automatic and autonomous systems. Knows how the safety system in AGV trolleys and AMR mobile robots works.
Has advanced knowledge of machine design and creation of technical documentation.
Has advanced knowledge in the field of mechatronics, including issues used to design, test and model drive systems and machine control.

Skills:
The student has the ability to self-educate, including: in order to "improve" professional competences.
The student is able to carry out a safety analysis for a selected issue related to the implementation of automatic travel using AGV/AMR
The student is able to program a simple mobile robot to carry out a selected transport mission
The student is able to name the basic components of an automatic and autonomous logistics system.
The student is able to select the appropriate kinematic system for given boundary conditions.
The student is able to select the drive system for given boundary conditions.
The student is able to design the mechanical component of an AGV trolley/AMR mobile robot, including, apart from the drive, also the frame and covers, taking into account the space for control, navigation and safety system components or electrical cables.
The student can distinguish an automatic system from an autonomous one.
Able to plan and organize individual and team work.

Social competences:
Is able to determine the importance of knowledge in solving cognitive and practical problems and to seek the opinion of experts in case of difficulties in solving the problem independently.
The student is aware of the social role of a technical university graduate, and especially understands the need to formulate and convey to society, in particular through the mass media, information and opinions regarding technical achievements and other aspects of engineering activities; makes every effort to convey such information and opinions in a generally understandable manner.
Able to think and act in a creative and entrepreneurial way.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Assessment in the form of a theory test related to lectures in the form of an electronic and traditional test consisting of 10-15 questions. Ratings: 3.0 <50%;60%), 3.5 <60%;70%), 4.0<70%;80%), 4.5<80%;90%), 5.0 < 90%;100%).
Ongoing monitoring of preparation for laboratories, optional final laboratory test in written form. Ratings: 3.0 <50%;60%), 3.5 <60%;70%), 4.0<70%;80%), 4.5<80%;90%), 5.0 < 90%;100%).

Programme content

Lecture:
1. Self-propelled AGV trolley and AMR mobile robot in industry
2. Construction of the mechanical component of self-propelled AGVs and mobile robots
3. Selection of the drive and other key mechanical components
4. Design of other mechanical components of the self-propelled AGV trolley / AMR mobile robot.
5. Automatic logistics train
6. Measuring transducers: positions, velocities, accelerations used in AGV/AMR
7. Safety analysis and implementation of safety functions in automatic and autonomous systems
8. Navigation of self-propelled AGVs and mobile robots
Lab:
1. Construction and assembly of the mechanical component of a small-scale mobile robot
2. Assembly of the control component and commissioning of the small-scale mobile robot
3. Introduction to programming a small-scale mobile robot
4. Programming a small-scale mobile robot to carry out a transport mission
5. Tests of the safety system based on LiDAR scanners of an industrial self-propelled AGV trolley / AMR mobile robot
6. Navigation of industrial self-propelled AGV / AMR mobile robot

7. Simulation studies of various kinematic systems used in AGV/AMR
8. Preparation of the concept of a self-propelled AGV trolley / AMR mobile robot for selected boundary conditions
9. Selection of basic mechanical components of the self-propelled AGV trolley / AMR mobile robot, including the drive for selected boundary conditions
10. Selection of security system components for selected boundary conditions
11. Design of the mechanical component of the self-propelled AGV trolley / AMR mobile robot, taking into account previously selected components and other systems, including space for the control system, navigation system, lighting and cables.

Course topics

none

Teaching methods

Lecture: presentation, computational examples
Laboratory: laboratory exercises in groups, case study, application examples

Bibliography

Basic:
1. Cook D., Budowa robotów dla początkujących, Helion, Warszawa, 2016.
2. Giergiel M. J., Hendzel Z., Żylski W., Modelowanie i sterowanie mobilnych robotów kołowych, Wydawnictwo Naukowe PWN, Warszawa, 2002
3. Kozłowski R., Sikorski A., Nowoczesne rozwiązania w logistyce, Wolters Kluwer Polska, 2013.

Additional:
1. Kagan E., Shvalb N., Ben-Gal I., Autonomous Mobile Robots and Multi-Robot Systems, Wiley, 2022.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00