COURSE DESCRIPTION CARD - SYLLABUS

Course name
Industrial automation systems [N2AiR1-SSiR>PO1-SAP]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/2

Area of study (specialization)
Control and Robotic Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
10

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student starting this subject should have basic knowledge of electrical engineering (with particular emphasis on AC circuits), automation (automatic control systems, controllers) and measurement of non-electrical quantities (e.g. measurement of temperature, pressure). Should have the ability to solve basic problems in the design of automatic control systems (selection of controller settings, stability testing, selection of sensors) and the ability to obtain information from indicated sources. He should also understand the need to broaden his competences and be ready to cooperate within a team. In addition, in the field of social competence, students must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

Providing students with basic knowledge of automation, in the selection of elements, design and programming of integrated building automation systems. Developing students' skills to solve design problems related to electrical installation and automation used in residential and public buildings. Developing students' teamwork skills in solving simple engineering tasks.

Course-related learning outcomes

Knowledge
1. has specialized knowledge of distributed systems and communication protocols used in automation systems; [K2_W3]
2. has structured and in-depth knowledge related to control systems and control and measurement systems; [K2_W11]
3. has knowledge of modern solutions in the field of industrial automation; [K2_W12]
4. has basic knowledge about the life cycle of building automation systems and control and measurement systems; [K2_W13]
5. has the knowledge necessary to understand the legal aspects of engineering activities and the possibility of applying them in practice; [[K2_W14]
6. has the knowledge necessary to perform electrical measurements in buildings; [-]
Skills
1. can analyze and interpret project technical documentation of industrial automation systems and use scientific literature related to a given problem; [K2_U2]
2. is able to select and integrate the elements of a specialized measurement and control system, including: control unit, executive system, measurement system and peripheral and communication modules; [K2_U13]
3. is able to identify non-technical aspects, including legal ones, when formulating and solving tasks involving the design of automation and robotics systems; [K2_U14]
4. can design improvements (improvements) existing design solutions for automation components and systems; [K2_U20]
Social competences
1.is aware of the importance and understands the non-technical aspects and effects of engineering activities; is ready to develop professional achievements; [K2_K2]
2. is aware of the responsibility for their own work and is ready to comply with the rules of teamwork and be responsible for jointly implemented tasks; [K2_K3]
3. understands that a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which devices and their components may function are necessary; [K2_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
The knowledge acquired during the lecture is verified on the basis of the evaluation of the implementation of the automation installation project of the selected part of the production line. The project is carried out in a group of 2 people. The project evaluates: solution to the problem, functionality of the created application, technical documentation.
The skills acquired during laboratory classes are verified on the basis of a final test consisting of 5-7 questions/tasks with different points depending on their difficulty level and on the basis of a prepared report. Passing threshold: 50% of points.

Programme content

The lecture program covers the architecture of integrated automation systems, in which closed and open systems as well as centralized and decentralized systems can be distinguished. Tasks of automation systems related to communication between industrial automation devices, programming PLC controllers, use of ANN and AR in industry. Product identification methods on an industrial line.

Course topics

The lecture program covers the following issues: definition of basic concepts such as industry 4.0, IIOT, smart sensor, RFID. The architecture of integrated automation systems, where a distinction can be made between closed and open systems, and centralized and decentralized systems. Tasks of automation systems, such as communication between industrial automation devices, PLC programming, RFID technology, use of ANN and AR in industry. Product identification methods on the industrial line (barcodes, QR codes, RFID). Discussion of the open communication protocol on the example of the IO-Link protocol. Communication via Profinet protocol. Social competences 1. is aware of the importance and understands the non-technical aspects and effects of engineering activities; is ready to develop professional

achievements; [K2_K2] Presentation of the OPC UA communication protocol. Overview of computer data exchange formats such as: JSON, XML, MQTT. Presentation of the differences between relational and non-relational database management systems on the example of MySQL and MongoDB. The use of the MES system for production management (organisation, operation and supervision of processes in production plants) which ensures maximum efficiency while reducing costs.
Laboratory classes are conducted in the form of fifteen 2-hour exercises, taking place in the laboratory, preceded by a 2-hour instruction session at the beginning of the semester. Exercises are carried out by 2-person or 3-person (depending on the size of the group) teams of students. The laboratory program covers the following topics: PLC programming, support for digital and analog inputs and outputs, OPC UA server configuration, NodeRed development tool - data exchange formats, OPC UA client configuration using NodeRed, configuration of communication in the profinet network, RFID gateway and head support, communication via IO-Link. Configuration of intelligent sensors. Machine learning of IIOT devices. Using databases to store information from the PLC. Production management systems. Scene design for augmented reality (AR) systems. Pneumatic device in automation.

Teaching methods

Teaching methods:
1. lecture: multimedia presentation, illustrated with examples of project tasks,
2. laboratory exercises: practical exercises, performing experiments, discussion, teamwork
3. Presentation of the industry 4.0 production line

Bibliography

Basic
1. Mystkowski, Arkadiusz. Sieci przemysłowe PROFIBUS DP i PROFINET IO. Oficyna Wydawnicza Politechniki Białostockiej, 2012.
2. Kasprzyk, Jerzy. Sterowniki PLC. Uniwersytet Rzeszowski. Katedra Mechatroniki i Automatyki, 2013.
3. Technologia informatyczna - Techniki automatycznej identyfikacji i gromadzenia danych (AIDC) - Słownictwo zharmonizowane - Część 3: Identyfikacja przy wykorzystaniu fal radiowych (RFID) PN-EN ISO/IEC 19762-3. Polski Komitet Normalizacyjny, © Copyright 2012.
4. Marcin Fojcik and Kamil Folkert. Introduction to OPC UA performance
5. S.K. Ong and A.Y.C. Nee. Virtual and augmented reality applications in manufacturing. Springer, cop. 2004.
Additional
1.Ioana Culic, Alexandru Radovici, Cristian Rusu. Komercyjne i przemysłowe aplikacje Internetu rzeczy na Raspberry Pi : prototypowanie rozwiązań IoT. APN Promise, 2020.
2. Kozłowski Artur, Jura Przemysław. Innowacyjne rozwiązania IT w Przemyśle 4.0. Wydawnictwo Wyższej Szkoły Technicznej w Katowicach, 2022.

Breakdown of average student's workload

	Hours	ECTS
Total workload	70	3,00
Classes requiring direct contact with the teacher	30	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,00