COURSE DESCRIPTION CARD - SYLLABUS

Course name
Selected applications of programmable controllers [S2AiR2-ISA>PO2-WZSP]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/2

Area of study (specialization)
Intelligent Control Systems

Profile of study
general academic

Level of study
second-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

3,00

Coordinators

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Lecturers

Prerequisites

A student beginning this course should have basic knowledge of discrete process control, especially programmable controllers and industrial networks, basics of automation and metrology in the field of measurements of various physical quantities. They should be able to solve basic problems in designing automatic control systems, including: selection of the structure and parameters of controllers, selection of measurement sensors. He/she should also have the ability to acquire information from indicated sources, understand the necessity of broadening his/her competence and be ready to start cooperation within a team.

Course objective

1. To teach students the use of programmable controllers in industrial automatic control, to describe control objects and to apply specific control algorithms and their implementation using various programming languages. 2. To develop in students the ability to solve design problems concerning control systems with programmable controllers, especially in distributed control systems 3. To develop in students teamwork skills in solving advanced control problems.

Course-related learning outcomes

Knowledge:
1. has a well-structured and detailed knowledge of control systems and control and measurement systems, especially in the field of distributed control systems and programmable controllers; [K2_W11].
2 has basic knowledge about the life cycle of automation and robotics systems and control and measurement systems; [K2_W13].
3. has a structured, theoretically based, detailed knowledge of methods of analysis and design of control systems typical for applications in industrial automation
4. has knowledge of development trends and the most significant new achievements in the field of industrial automation and related scientific disciplines
5. knows the basic criteria for synthesis and methods of regulator tuning, tools and techniques for selecting regulator parameters and identifying control objects;

Skills:
1. is able to select and integrate elements of a specialized measurement and control system including: control unit, actuator, measurement system and peripheral and communication modules; [K2_U13].
2. is able to make a critical analysis of the operation of control systems and robotics systems; also has the ability to design automation systems using programmable controllers; [K2_U19].
3. is able to design improvements (enhancements) of the existing design solutions of elements and systems of automation and robotics; [K2_U20].
4. is able to design and implement a complex device, object or system taking into account non-technical aspects; [K2_U23].

Social competences:
1. is aware of the necessity of professional approach to technical issues, scrupulous familiarization with documentation and environmental conditions in which devices and their elements may operate; [K2_K4].
2. is aware of the responsibility for his/her own work and is ready to comply with the rules of teamwork;

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired in lecture is verified by a 60-minute colloquium and individual discussion of issues in the last lecture. The test consists of 10-15 questions (test and open), with varying scores. The pass mark is 50%. Issues on which the questions are based are made available to students during the semester.
The skills acquired in the laboratory classes are verified on the basis of reports and the final test, consisting of 5-7 questions/tasks, scored differently depending on their difficulty. The pass mark is 50%.

Programme content

1. Communication systems of programmable controllers. Local area network analysis in a layered ISO-OSI model scheme. Examples of structure, operation and application of networks: AS-i, Modbus, CAN, Profibus, HART, Ethernet-Powerlink. Distributed control systems (DCS) in control systems.
2. Algorithms of continuous processes control, modifications of elementary PID algorithm. Methods of controller tuning. Practical issues of using controllers for various technological objects.
3. Features, functions and tasks of supervisory control systems and data acquisition systems, their archiving, presentation, analysis. Connection of PLC with SCADA system - DDE, OPC standards. Multi-level control systems. Human Machine Interface (HMI) design for such systems. Examples of commercial SCADA-HMI packages, advantages and disadvantages of the solutions used. Reporting and alarming systems.
4. Selected issues in PLC programming, including the use of text language, the use of dedicated libraries (OpenPLC Control, OpenPLC MotionCotrol) and the use of programming environments (TIAPortal, CodeSys).
Topics of the laboratory classes: Programming of advanced PLC functions, configuration of selected SCADA systems (InTouch, LabView), cooperation of SCADA system with PLC, use of OPC server (InTouch), programming of sample application for device models in the laboratory. Use of alarming and reporting system, configuration of recipe system. Configuration of selected local area networks (Modbus, Profibus, Profinet). Basic diagnostics of local area networks - fault finding.
Students during classes analyze and implement topics of projects related to the scientific research of the department, especially in the implementation of digital control algorithms on programmable controllers.

Course topics

none

Teaching methods

1. Lecture: multimedia presentation, illustrated by examples given on the board.
2.Laboratory exercises: performing laboratory exercises with PLCs and operator panels, realization of tasks given by the instructor - practical exercises.

Bibliography

Basic:
1. Lecture materials progressively provided by the instructor in electronic form.
2. Websites of individual consortia of local networks, company documentation of Honeywell, Siemens, Emerson.
3. Kwiecień R.: Komputerowe systemy automatyki przemysłowej: Wydawnictwo Helion, Gliwice 2013.
4. Kwaśniewski J. Programowane sterowniki przemysłowe w systemach sterowania, Kraków 1999
5. Kwaśniewski J. Sterowniki SIMATIC S7-1200 i S7-1500 w zaawansowanych systemach sterowania, BTC
2018

Additional:
1. Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. Protokoły i standardy, Wydawnictwa Komunikacji i Łączności
2. Nawrocki W.: Komputerowe systemy pomiarowe, Wydawnictwa Komunikacji i Łączności
3. Clarke G. Practical Modern SCADA Protocols, Elsevier, 2004
4. Industrial Communication Technology Handbook, ed. by Richard Zurawski, CRC Press, New York 2015
5. Industrial Communication Ssytem, ed. by Bogdan M. Wilamowski, J. David Irwin, CRC Press, New York 2011

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
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)	30	1,00