POZNAN UNIVERSITY OF TECHNOLOGY

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Distributed system of automation [N1AiR2>PO4-SysRA]

Course

Field of study	Year/Semester
Automatic Control and Robotics	3/6

Area of study (specialization)	Profile of study
–	general academic

Level of study	Course offered in
first-cycle	Polish

Form of study	Requirements
part-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
10	20	0

Tutorials	Projects/seminars	
0	0	

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge: A student beginning this course should have basic knowledge of: programming, construction and operation of programmable logic controllers (PLCs), basics of automation, basics of electronics, use of driver programming tools in Windows operating system. Skills: He/she should have the ability to solve basic problems using programming tools to perform control and communication tasks and the ability to obtain information from indicated sources. Social Skills: In addition, in the field of social skills, the student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

To provide students with basic and advanced knowledge of systems used to transmit process information in measurement and control systems used in industrial automation. To develop students' ability to solve problems in design tasks and use distributed automation systems. Developing students' teamwork skills.

Course-related learning outcomes

Knowledge:
1. has a structured knowledge of computer architectures, industrial controllers and communication

networks, including real-time systems;
2. has a basic knowledge of microprocessor system architectures and programming, and has a knowledge of selected high and low level microprocessor programming languages;
3. has knowledge and understanding of the design and operation of programmable industrial controllers and their analog and digital peripherals; knows and understands the principle of operation;

Skills:
1. is able to construct an algorithm for a simple engineering task and to implement, test and run it in a selected development environment on a computer;
2. is able to install, configure and program an algorithm for a simple measurement and computation-control task and to implement, test and run it in a selected environment;
3. is able to design and implement a local ICT network (including industrial network) through the selection and configuration of communication elements and devices (wired and wireless);

Social competences:
1. is aware of the responsibility for their own work and willingness to comply with the rules of teamwork and take responsibility for the tasks performed jointly;
2. is able to appropriately prioritize the implementation of the tasks defined by himself or others;
3. is aware of the necessity of a professional approach to technical issues, scrupulous familiarization with technical documentation, observing the rules of professional ethics;

Methods for verifying learning outcomes and assessment criteria
Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by one 45-minute colloquium during the 7th lecture. The colloquium consists of 8-10 questions (test and open questions), differently scored. The credit threshold: 50% of points. The credit issues, on the basis of which the questions are prepared, are made available to students using the university's e-mail system or remote access WEB.
The skills acquired during the laboratory classes are verified on the basis of prepared reports and the final credit colloquium, consisting of 5-7 questions/tasks, differently scored depending on their level of difficulty. The credit threshold: 50% of points.

Programme content

W1. Introduction to industrial network communication issues.
W2. Industrial communication networks: types of networks in industrial communication structure, network operation schemes, network communication standards, features of industrial networks, communication interface of the controller, transmission media used in industry, norms.
W3. Configuration of PLC network systems: basic and advanced network configuration tools, principles of communication network configuration and its interfaces, network configuration model and its realization physical, functional, hardware and software compatibility of network elements, application
layer functions for realization of communication of the controller program.
W4. Profibus DP network and its use: Profibus DP a communication standard, physical layer, coding, network transmission methods, basic properties and functions of line layer services, communication primitives, organization of the communication interface, message structure, transmission rules, types of messages, application layer and its communication functions available from the programmer level, rules and schemes of data exchange, examples of configuration, parameterization and programming of Profibus DP network operation.
W5. CAN/CANopen network and its use: CAN against communication standard, basic concepts and properties of CAN network, physical layer, message format and components, message encoding, arbitration, communication error detection, CANopen application layer, communication profile, CANopen application profiles, data types and bit transfer sequences, communication models in CANopen, dictionary of communication objects, example of application of CANopen protocol to control drives.
W6. Industrial Ethernet networks: Profinet or Powerlink: base protocols, network operation models, communication channels, determinism - isochronous cycles, configuration schemes, application layer functions.

Laboratory exercises are carried out in 2/3-person teams, which use 6 workstations equipped with configured computer and communication equipment, programming tools, programmable controllers and devices with communication interfaces. Laboratory tasks consist in configuring hardware and software

devices, writing a program for a controller or controllers, starting them and testing them until they are working properly.

Laboratory training program:

C1. Presentation of industrial controllers with communication interfaces in laboratory configurations and discussion of the principles of their operation and operating safety.

C2. Programming with the use of communication networks, project construction, hardware configuration, writing, launching and testing the program in the chosen programming language.

C3. Configuration and testing of communication connections in industrial communication networks.

C4. Communication with executive devices by means of network connections.

C5. Communication with sensors and digital measuring devices by means of network connections.

C6. Transmission of process data from controller programs via Profibus DP networks.

C7. Transmission of process data from controller programs using the Profinet network.

Course topics

Teaching methods

1. lecture: multimedia presentation, solving sample project tasks;
2. laboratory exercises: multimedia presentation illustrated with examples given on the board and the performance of tasks given by the instructor - practical exercises;

Bibliography

Basic:

1. W. Solnik, Zb. Zajda, Sieć Profibus DP w praktyce przemysłowej. Przykłady zastosowań. Wydawnictwo BTC, Legionowo 2013.
2. K. Sacha, Sieci miejscowe PROFIBUS, Wydawnictwo MIKON, Warszawa 1998.
3. C_CAN User?s Manual, Revision 1.2, Robert Bosch GmbH 1999, edition 06.06.00.
4. H. Boterenbrood, CANopen high-level protocol for CAN-bus, NIKHEF, Amsterdam, ver. 3, March 20, 2000.
5 EPSG Draft Standard 301 Ethernet POWERLINK Communication Profile Specification, Version 1.1.0, EPSG 2008.
6. J. Kwaśniewski. Programowalny sterownik SIMATIC S7-300 w praktyce inżynierskiej, Wydawnictwo BTC, Legionowo 2009.

Additional:

1. STEP7 Professional, Reference Manual, Siemens A.G., 1998.
2. Ladder Logic (LAD) for S7-300 and S7-400 Programming, Reference Manual, 6ES7810-4CA10-8BW1, 05.2010, Siemens A.G.
3. S7-CPs for Industrial Ethernet. Manual Part B3A, Release 2/2006, SIEMENS 2006.
4. SIMATIC System Software for S7-300/400 System and Standard Functions, Volume ? Reference Manual, Edition 03/2006, SIEMENS, ES7810-4CA08-8BW1.
5. CANopen - Application Layer and Communication Profile, CiA Draft Standard 301, Version 4.02, 13 February 2002.
6. CANopen - Device Profile Drives and Motion Control, CiA Draft Standard Proposal 402, Version 2.0, 26. July 2002.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	2,00