COURSE DESCRIPTION CARD - SYLLABUS

Course name

Digital communication systems

Course

Field of study

Automatic Control and Robotics

Year/Semester

2/3

Area of study (specialization)

Control and robotics systems

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

polish

Form of study

part-time

Requirements

elective

Number of hours

Lecture

12

Laboratory classes

12

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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Faculty of Control, Robotics and Electrical

Engineering

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Responsible for the course/lecturer:

Prerequisites

Knowledge: A student beginning this course should have basic knowledge of: programming, construction and operation of programmable controllers, electric drives, basics of automation, basics of electronics, use of programming tools in Windows operating system.

Skills: The student should have the ability to solve basic problems with the use of programming tools to perform control and communication tasks and the ability to obtain information from indicated sources.

Social Skills: The student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture and respect for other people.

Course objective

1. Providing students with basic and advanced knowledge of industrial communication technologies, in particular of the construction and operation principles of industrial network communication used in the implementation of measurements, control, configuration, parameterization and programming of automation and robotics devices, the use of programming tools to carry out communication tasks.

2. Acquiring knowledge and skills of applying selected communication systems, programmable equipment for the realisation of control of industrial processes, acquiring the ability to use the selected programming language intended for programming a control system using the selected communication system, acquiring the ability to operate tools used for programming industrial systems.

3. Developing in students the ability to solve problems in the field of programming and network communication in industry.

Course-related learning outcomes

Knowledge

1. has a structured knowledge of computer architectures and computer networks;

2. has a basic knowledge of microprocessor system architectures and programming, and has 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 analogue and digital peripherals; knows and understands the principle of operation;

Skills

1. is able to select and integrate elements of a specialized measurement and control system, including: control unit, executive system, measurement system and peripheral and communication modules;

2. is able to construct an algorithm for a simple engineering task and to implement, test and run it in a selected computer programming environment;

3. is able to design and implement a local IT network (including industrial network) through the selection and configuration of communication elements and devices (wired and wireless);

Social competences

1. is aware of the need for a professional approach to technical issues, scrupulous familiarisation with the documentation and environmental conditions under which the equipment and its components may operate;

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 a 45-minute colloquium consisting of 8-10 questions, differently scored. The pass mark is 50% of the points. The coursework on the basis of which the questions are prepared will be sent to students via e-mail using the university's e-mail system.

Skills acquired during laboratory classes are verified on the basis of the assessment of the preparation for laboratory classes and protocols drawn up on time after each laboratory exercise.

Programme content

1. Introduction to the issues of industrial network communication: elements of communication in automation and robotics, communication interface, cooperation of measurement, control and executive elements in a distributed system, use of real-time system in control and communication.

2. Industrial communication networks: types of networks in an industrial communication structure, features of industrial networks, network operation schemes, communication interface of a controller, transmission media used in industry, standards in network communication, norms.

3. Configuration of network systems: basic and advanced network configuration tools, principles of communication network configuration and its interfaces, network configuration scheme and its physical, functional, hardware and software implementation, compatibility of network elements.

4. CAN and its use: CAN against standard reference model, basic concepts and properties of CAN, physical layer, message format and components, message coding, arbitration, communication error detection, time requirements in CAN communication, systems supporting CAN interface,

5. CANopen communication profile: data types and bit transfer sequences, communication models in CANopen, directory-dictionary of communication objects PDO, SDO, SYNCH, TIME, EMCY, NMT, Heartbeat, Node Guarding, CANopen application profiles, example of application of CANopen protocol for drive control.

6. Industrial Ethernet - Powerlink: base protocols, network operating diagrams, communication channels, determinism - isochronous cycles, application layer functions for Powerlink networks, cyclic and acyclic information transmission, usage examples.

Laboratory exercises are carried out in teams of 2-3 people, which use 6 workstations equipped with configured computer and communication equipment, programming tools and devices with communication interfaces. Laboratory tasks consist in the configuration of hardware and software devices, writing a program supporting communication, its launch and testing until the correct operation is achieved.

The programme of laboratory exercises:

C1. Identification of the communication frame of the CAN network by means of monitoring software.

C2. Using the CANopen communication profile to configure and parameterize the DC drive controller.

C3. Configuration and reading of data from sensors and digital measuring devices by means of network connections.

C4. Hardware identification of the contents of the communication frame in the CAN network.

C5. Configuration, parameterisation, diagnostics of network control of elevator drives.

C6. Transmission of process data from the controller program via the Powerlink network.

Teaching methods

1. Lecture: presentation illustrated with examples given on the board, multimedia presentations.

2. Laboratory exercises: programming of tasks and their launch on selected software and hardware platforms and testing for changing task parameters, case studies.

Bibliography

Basic

1. Grzejszczyk El., Fryśkowski B., Systemy transmisji danych, WKŁ 2010.

2. Boterenbrood H., CANopen high-level protocol for CAN-bus, NIKHEF, Amsterdam, ver. 3, March 20, 2000.

3. Ethernet POWERLINK, Communication Profile Specification, EPSG (Ethernet POWERLINK Standardisation Group) DS 301 V1.2.0, 2013.

4. Fall K.R., W. Stevens R., TCP/IP od środka. Protokoły. Wydanie II. Wydawnictwo Helion, Gliwice 2013.

Additional

1. Krysiak K., Sieci komputerowe. Kompendium. Wydanie II, Wydawnictwo Helion, 2005.

2. Wójtowicz W., ANALIZA ROZWIĄZAŃ SIECI PRZEMYSŁOWYCH O OTWARTYM KODZIE OPARTYCH NA TECHNOLOGII ETHERNET, Studia Informatica, Vol. 32, No.3A(98), 2011.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	24	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	26	1,0

[1] delete or add other activities as appropriate