COURSE DESCRIPTION CARD - SYLLABUS

Course name

Networks and distributed control systems

Course

Field of study

automatic control and robotics

Year/Semester

3/6

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

30

Laboratory classes

30

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

PhD eng. Dominik Łuczak

email: Dominik.Luczak@put.poznan.pl

tel. 48 61 665 2557

Faculty of Control, Robotics and Electrical Engineering

ul. Piotrowo 3A 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Knowledge: A student starting this subject should have basic knowledge of electronics and basic programming.

Skills: The student should have the ability to solve basic problems in the field of digital signal processing and the ability to obtain information from specified sources. He should also understand the need to expand his competences and be ready to cooperate in a team.

Social competences: In addition, in the area of social competences, the student must exhibit such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

The aim of the course is to learn the theoretical foundations, principles of operation and possible applications of devices communicating with other objects of a distributed control system without human intervention (Machine to Machine, M2M) both wired and wirelessly through a global Internet network. The student after completing education should be able to:

1) develop a simple application for a mobile device allowing remote management of a selected item connected to the global network,

2) develop a device enabling communication with other objects on the Internet,

3) prepare the user interface for remote management of one and several objects.

Course-related learning outcomes

Knowledge

1. The student has basic knowledge of the operation and use of IT tools for rapid prototyping as well as design, simulation and visualization of automation and robotics systems and systems as well as for recording the design of mechanical structures - [K1_W10],

2. has structured knowledge of the structures and principles of operation of analog and discrete control systems (in open and feedback systems) as well as linear and simple non-linear analog and digital controllers - [K1_W16],

3. knows and understands at an advanced level the structure and principles of operation of programmable industrial controllers as well as their analog and digital peripheral systems; knows and understands the principle of operation of basic communication interfaces used in industrial control systems - [K1_W19],

4. knows the methods, techniques, tools and materials used to solve simple engineering tasks in the field of automation and robotics - [K1_W23].

Skills

1. The student is able to determine and use models of simple electromechanical systems and selected industrial processes, and to use them for the purposes of analysis and design of automation and robotics systems - [K1_U11],

2. can check the stability of linear and selected nonlinear objects and dynamical systems - [K1_U13],

3. can select parameters and settings of the basic industrial controller and configure and program the industrial programmable controller - [K1_U18],

4. is able to assess the usefulness of routine methods and tools for the design of automation and robotics systems and select and apply the appropriate method and tools - [K1_U24],

5. can design and implement a local teleinformation network (including industrial one) through the selection and configuration of communication elements and devices (wired and wireless) - [K1_U28].

Social competences

1. The student is aware of the responsibility for their own work and readiness to submit to the rules of teamwork and responsibility for jointly performed tasks; is able to lead a small team, set goals and define priorities leading to the implementation of a task; is ready to perform professional roles in a responsible manner - [K1_K3],

2. is ready to define priorities for the implementation of the tasks set by himself or others - [K1_K4],

3. is aware of the need for a professional approach to technical issues, scrupulous reading of the documentation and environmental conditions in which the devices and their components may function - [K1_K5].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in the scope of lectures:

based on answers to questions about the material discussed in previous lectures,

b) in the scope of the laboratory:

based on assessment of knowledge and understanding of current issues presented in the course of the subject.

Summative rating:

a) in the scope of lectures, verification of assumed learning outcomes is carried out by:

i. assessment of knowledge and skills demonstrated during the written test.

ii. discussion of test results,

b) in the scope of laboratory, verification of assumed learning outcomes is carried out by:

i. assessment of student's preparation for individual classes,

ii. continuous assessment, during each class (oral answers) - rewarding the increase in the ability to use known principles and methods,

iii. assessment of reports prepared partly during classes and also after their completion,

iv. development of a control and measurement system.

Obtaining additional points for activity during classes, in particular for:

i. independent construction of the electronic control and measurement system module and preparation of documentation

ii. effectiveness of applying the acquired knowledge while solving a given problem

iii. comments related to the improvement of teaching materials.

Programme content

The lecture program includes the following topics:

1. Elements and tasks of the Internet of Things application, system construction, market, development modules, programming environments. Motivation to learn. Data exchange format between systems - JSON, Restful interface.

2. Web applications with a restful interface developed in PHP.

3. Linux operating system configuration - GPIO, SPI, UART, I2C configuration.

4. Linux system - access rights, shell scripts, user creation, SSH remote access.

5. Applications for mobile devices with Restful interface.

6. Web interface structure - HTML, jQuery.

7. Web interface interaction - JS, jQuery.

8. Presentation of the web interface - CSS, Bootsrap.

9. Linux operating system configuration - CRON configuration, startup files, network settings.

10. Ethernet, IP, TCP, UDP protocols.

11. Addressing in the network - DHCP, ARP.

12. HTTP, application layer protocols, MQTT.

13. Security of network applications - TLS.

14. Mockups and application prototyping. Creating paper application mockups.

15. Summary.

The program of laboratory classes includes the following issues:

1. Organizational classes - familiarization with OHS apparatus and footnotes, introduction to the design environment. JSON data exchange format.

2. Implementation of the restful interface in PHP

3. Linux operating system configuration - GPIO, SPI, UART, I2C configuration

4. Developing an application for Linux to support GPIO, SPI, UART, I2C interfaces (preferably C language).

5. Paper user interface design.

6. Application development for Android - as a user interface.

7. Implementation of the interface for WWW - HTML, jQuey

8. Implementation of the interface for WWW - Boostrap, jQuey

9. Implementation of the web interface - charts and notifications.

10. Implementation of the C # application - as a user interface.

11. Application of signal processing algorithms to analyze signal features.

12. Development and testing of the control and measurement system.

13. Optimization of the user interface due to the refresh period.

14. System security.

15. Presentation of the final task: measurement and control system.

Teaching methods

1. Lecture: multimedia presentation illustrated with computer simulations and a real system

2. Laboratory classes: the use of single-board development modules with a set of sensors, programming environments for Internet applications

Bibliography

Basic

1. Ilya Grigorik, Wydajne aplikacje internetowe. Przewodnik, Helion, 2014 / Ilya Grigorik, High Performance Browser Networking, 2013

2. Justin Hutchens, Skanowanie sieci z Kali Linux : receptury : bezpieczeństwo sieci w Twoich rękach!, Helion, 2015 / Justin Hutchens, Kali Linux Network Scanning Cookbook, 2014

3. Adam Gerber, Clifton Craig, Android Studio : wygodne i efektywne tworzenie aplikacji, Helion, 2016 / Adam Gerber, Clifton Craig, Learn Android Studio Build Android Apps Quickly and Effectively, 2015

4. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley, 2013.

Additional

1. Karol Rogowski, Świat poza jQuery : biblioteki : AngularJS, KnockoutJS i BackbonesJS, Wydawnictwo Naukowe PWN, 2014.

2. Arkadiusz Mystkowski, Sieci przemysłowe PROFIBUS DP i PROFINET IO, Oficyna Wydawnicza Politechniki Białostockiej, 2012.

3. Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. Protokoły i standardy, Wydawnictwa Komunikacji i Łączności 2008

4. Komunikacja danych cyfrowych w pomiarach i sterowaniu - Część 1: Zbiór profili do wytwarzania ciągłego i dyskretnego związany z magistralą miejscową stosowaną w przemysłowych systemach sterowania PN-EN 61784-1, Polski Komitet Normalizacyjny, 2005.

5. Bruce Hartpence, Routing i switching : praktyczny przewodnik, Wydawnictwo Helion, 2013.

6. Troy Miles, jQuery Essentials, 2016.

7. Raimond Pigan, Mark Metter, Automating with PROFINET: Industrial Communication Based on Industrial Ethernet, 2nd Edition, 2015.

8. Bruce Hartpence, Packet Guide to Routing and Switching, 2011.

9. Łuczak D., Remote laboratory with WEB interface, Computer Applications in Electrical Engineering, Vol. 9, str. 257-268, Poznań, 2011, ISSN 1508-4248.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	5,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, tasks preparation) [1]	90	3,0

[1] delete or add other activities as appropriate