POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name

Applications of industrial controllers

Course

Field of study

Automatic Control and Robotics

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3 / 6

Profile of study

general academic

Course offered in

Polish

Requirements

elective

Number of hours

Lecture

15

Tutorials

-

Laboratory classes

30

Projects/seminars

-0

Other (e.g. online)

-

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Wydział Automatyki, Robotyki i Elektrotechniki

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Responsible for the course/lecturer:

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Prerequisites

The student starting this subject should have a basic knowledge of mathematics - mainly knowledge of mathematical logic elements. Should have the ability to efficiently use a PC and external devices as well as the ability to obtain information from specified sources.

He should also have a basic knowledge of the basics of automation and control theory. Should have the ability to actively participate in organized lectures for a large group of people, be aware of the need to expand theoretical and practical knowledge and constantly update acquired knowledge due to dynamic technological and systemic changes in modern technology.
Social Competences: He should also understand the need to broaden his competences and be ready to cooperate as part of a team implementing e.g. a joint project.

Course objective

1. To provide students with basic knowledge on the use of programmable industrial controller systems covering data acquisition issues and their use in control, especially in automation and robotics problems. Developing students' skills in designing their own control systems based on open embedded platforms.
2. Providing students with basic knowledge regarding the implementation of hardware solutions of control systems. Developing the ability to plan calculations in data processing systems in parallel in such a way that the resulting system works at the highest possible speed matched to the capabilities of the target platform.
3. Developing students' teamwork skills during the implementation of the final project within the laboratory.

Course-related learning outcomes

Knowledge

1. has structured knowledge of computer architectures, computer systems and networks, and operating systems including real-time operating systems; - [KW_9]

2. knows and understands at an advanced level the construction and operating principles 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; - [KW_19]

Skills

1. can use selected tools for rapid prototyping of automation and robotics systems; - [KU_13]

2. can choose parameters and settings of a basic industrial controller and configure and program an industrial programmable controller; - [KU_18]

3. is able to identify and formulate a specification of simple engineering tasks in the field of automation and robotics; - [KU_28]

4. is able to integrate and program specialized robotic systems; - [KU_12]

5. is able to select and integrate elements of a specialized measuring and control system, including: control unit, executive system, measuring system as well as peripheral and communication modules; - [KU_28]

6. is able to design and implement a local teleinformatic network (including industrial) through the selection and configuration of communication elements and devices (wired and wireless); - [KU_24]

Social competences

1. is aware of the responsibility for own work and readiness to comply with the rules of teamwork and taking responsibility for jointly implemented tasks; can manage a small team, set goals and set priorities for achieving them; is ready to perform responsible professional roles; - [K_K3]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in terms of lectures: based on answers to questions about the material discussed in previous lectures,

b) in the scope of laboratories / exercises: based on the assessment of the current progress of tasks,

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 problem-type written exam consisting of 5 questions out of 40 questions presented on the general list of questions, previously provided to students.

Grading rules:

5.0 - above 90% of exam points (W); average of grades from lab exercises above 4.75 (L)

4.5 - 80% -90% of exam points (W); average of grades from lab exercises 4.25-4.75 (L)

4.0 - 70% -80% of exam points (W); average of grades from lab exercises 3.75-4.25 (L)

3.5 - 60% -70% of exam points (W); average of grades from lab exercises 3.25-3.75 (L)

3.0 - 50% -60% of exam points (W); average of grades from lab exercises 2.75-3.25 (L)

2.0 - less than 50% of exam points (W); average grades from lab exercises below 2.75 (L)

ii. discussion of passing results,

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

a. assessment of student's preparation for individual laboratory sessions (entrance test)

b. assessment of the laboratory exercise carried out (report)

Programme content

The lecture program includes the following topics:

Presentation of the communication problem in the sample control system. Presentation of the basic communication protocols in embedded control systems.

Presentation of the problem of video data analysis in an exemplary surveillance system based on the system working in the task of detecting theft using industrial cameras. A set of algorithms for video data analysis is presented here, such as: background object detection (Gaussian mix algorithm and expected value maximization) and their classification (k-means algorithm).

Presentation of the design process of a complex control system based on the Raspberry Pi embedded platform.

Presentation of the implementation of peripheral modules on the embedded platform (e.g. Zynq) in the equipment description language (VHDL).

Presentation of the implementation of peripheral device drivers for the Linux operating system.

Presentation of the main issues related to the safety and ergonomics of control systems on the example of the use of industrial controllers and flow computers in the gas industry.

Laboratory classes are conducted in the form of 2-hour exercises that take place in the laboratory, preceded by a 2-hour instructional session at the beginning of the semester. The initial part of the laboratory consists of exercises carried out by teams of 1 students according to exercises selected by the teacher and given in the script to the laboratory. In the middle of the semester, students are issued descriptions of projects to be implemented as part of the exercises. Projects are implemented individually or in teams of 2, depending on the expected difficulty of project implementation.
The laboratory program includes the following issues:
Designing a control system based on the embedded Linux operating system.
Designing the communication and event control system on the example of video data analysis using OpenCV and C ++.
Designing Linux operating system drivers.
Part of the above-mentioned program content is implemented in the student's own work.

Teaching methods

Teaching methods:

1. lecture: multimedia presentation, presentation illustrated with examples given on the board, as well as multimedia shows and demonstrations using, among others embedded systems with the Linux operating system.

2. laboratory exercises: performing experiments, examining prepared problems of implementing control systems, discussion, teamwork, multimedia show, workshops - independent project development, e.g. a simple Linux operating system driver.

Bibliography

Basic
1. Ryszard Jakuszewski, Podstawy Programowania Systemów Sterowania, Proficy HMI/SCADA – iFIX 5.0 EN, ISBN 978-83-60716-67-0

2. ARM System Developer's Guide: Designing and Optimizing System Software, Andrew Sloss, Chris Wright, Dominic Symes, Morgan Kaufmann, ISBN13: 9781558608740, 2004.

Additional
1. Wbudowane systemy mikroprocesorowe, Aleksander Timofiejew, Siedlce: Wydawnictwo Akademii Podlaskiej, ISBN: 978-83-7051-579-9, 2010.

2. http://learn.adafruit.com/category/raspberry-pi

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3
Classes requiring direct contact with the teacher	60	2
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	30	1

1 delete or add other activities as appropriate