COURSE DESCRIPTION CARD - SYLLABUS

Course name

PO 2.4.1 Systemy wbudowane - EC 2.4.1 Embedded systems

Course

Field of study
Teleinformatics

Year/Semester
1/2

Area of study (specialization)

Profile of study
general academic

Level of study
second-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
0

Projects/seminars
0/0

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
dr inż. Łukasz Matuszewski

Responsible for the course/lecturer:
dr inż. Michał Maćkowski

Prerequisites

Basic knowledge of programming, construction of computer and microprocessor systems, and construction and operation of computer networks. Basic understanding of the theory of systems and measurement systems. Ability to analyze the program code. Knowledge of the design of digital circuits in FPGA technology. Basic knowledge of the synthesis of logic circuits. Ability to implement team projects.

Course objective

Students are getting to know the structure and basic features of embedded systems. Acquainting the fundamental realizations of embedded systems (e.g., PLC controllers, programmable systems, microprocessor systems). Learning the methods and techniques of automatic regulation and control. Introduction to the group of communication interfaces designed for embedded systems. They are getting to know sensor networks, the Internet of Things, and the security aspects of embedded systems.

Course-related learning outcomes

Knowledge

Students know the operation of embedded systems. He knows the methods of designing and synthesizing logic circuits. They get knowledge of the construction, principles of operation, and programming of PLC logic controllers, microcontrollers, and programmable circuits. He knows the elements and structures of modern measurement and control systems and control algorithms for automatic control systems. He knows the interfaces and communication standards in industrial automation systems. Knows the structure and parameters of a communication network designed to support sensors and detectors. Knows how to ensure the security of embedded systems.

Skills

Students can analyze and design an embedded system and its testing and implementation. They can identify the objects of regulation, use appropriate regulators and select their settings, develop control and steering programs for various programmable platforms, test them and run them in a chosen environment. Design and implement a local sensor network by selecting and configuring communication elements and devices. Can obtain data from the literature, standards, and catalog cards in Polish and English, interpret the received information, draw conclusions and apply them in practice.

Social competences

Students are open to the possibility of continuous training and understand the need to improve professional, personal, and social competencies. They are aware of the responsibility for their work and readiness to submit to the rules of teamwork and responsibility for jointly performed tasks. They can adequately define the priorities for implementing the scheme set by themself or others. They understand non-technical engineering activity determinants and a sense of responsibility for the designed electronic and telecommunications systems. He knows the basic principles of occupational health and safety.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written exam. The exam consists of 10-20 questions. You can get 0 or 1 point for each question. Based on which the questions are developed, final issues are presented during the lecture and constitute its program content.
Laboratory: The final grade (OK) is determined based on the student's preparation for the following sessions of laboratory classes (entry test), activity during the lessons, reports (reports) on the

laboratory exercises (OL), and the final examination (ZK) in the form of an independent the actual activity or project.
The weighted average is determined: OK = 0.4 x OL + 0.6 x ZK and evaluates:
5.0 for OK> 4.75;
4.5 for 4.75> OK> 4.25;
4.0 for 4.25> OK> 3.75;
3.5 for 3.75> OK> 3.25;
3.0 for 3.25> OK> 2.75;
2.0 for OK <2.75.

Programme content

Logic circuits (designing combinational and sequential circuits)
Programming PLC controllers (ST and LD languages)
Introduction to automation (basic concepts, division of control systems, regulation techniques)
Object identification (operator transmittance, impulse and step response, spectral transmittance)
Typical linear elements and terms (proportional, inertial, oscillating, integrating, derivative, time-delayed)
Stability of control systems (square root criterion, Hurwitz, Nyquist)
PID correctors and regulators (PI, PD correctors, P, I, PI, PD, PID regulators)
Object regulation (two-state, continuous regulation, regulation quality)
Methods of selecting controller settings (step response, limit vibrations, Z-N)
Discrete systems (discrete control systems, transfer function, algorithms, stability)
Interfaces and protocols (Modbus, FlexRay, LIN, CAN, I2C, SPI, RS485, 1wire)
Access to the Internet of Things IoT
Distributed sensor networks (LoraWAN)
Embedded Systems Security (Security Models: RBAC, ARBAC, CBAC, BLP, ACL, PUF functions)

Teaching methods

Lecture: multimedia presentation with examples presented on the blackboard.
Laboratories: Multimedia presentation, implementation of laboratory exercises according to the instructions, independent task solving. Work on computers with dedicated software and teaching sets intended for programming embedded systems (PLC controllers, modules with a microcontroller, or FPGA system).

Bibliography

Basic

Urbaniak A., Podstawy automatyki, Wydawnictwo PP, Poznań 2004
Kaula R., Podstawy Automatyki, Wydawnictwo Politechniki Śląskiej, Gliwice 2005
Karczewski J., Szuman P., SciLab Modelowanie i Symulacja Pracy Układów Automatyki, NAKOM 2019
Sałat R., Korpysz K., Obstawski P., Wstęp do programowania sterowników PLC, Wydawnictwo Komunikacji i Łączności 2014

Additional

White E., Making Embedded Systems. Design Patterns for Great Software, O'Reilly Media 2011
Głocki W., Układy Cyfrowe, Wydawnictwo Szkolne i Pedagogiczne 2010

Breakdown of average student's workload

	Hours	ECTS
Total workload	120	4.0
Classes requiring direct contact with the teacher	64	3.0
Student's own work (preparation for tests, preparation for laboratory classes, preparation for exam, literature studies)	56	1.0