COURSE DESCRIPTION CARD - SYLLABUS

Course name

Programowanie systemów pomiarowo-sterujących - Measurement and control systems programming

Course

Field of study
Teleinformatics

Year/Semester
1/1

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
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other (e.g. online)

Tutorials
0

Projects/seminars
0/0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

dr inż. Michał Maćkowski, Institute of Multimedia Telecommunications, Faculty of Computing and Telecommunications, 61 665 3859
michal.mackowski@put.poznan.pl

Responsible for the course/lecturer:

dr hab. inż. Maciej Wawrzyniak, Institute of Multimedia Telecommunications, Faculty of Computing and Telecommunications,
61 665 3835
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Prerequisites

A student has a basic knowledge of data structures and algorithms used in programming languages.

A student has a practical knowledge of methodology and techniques of programming in high-level languages. The student has knowledge of computer systems, the operation of peripherals and the management of computer resources by operating systems. A student has knowledge of the theory of electrical circuits, electrical metrology, and electronic components and systems.
Is able to extract information from literature, databases and other sources. Is able to participate in collaborative projects

Course objective

To introduce students to the modern measurement and control systems.
Learning the basics of control theory.
To introduce students with the methods of programming measurement and control devices in the NI LabVIEW environment. Learning to prototyping FPGAs in the NI LabVIEW environment.
Overview of the construction and operation of industrial PLC controllers.
Learning the basics of PLC programming.

Course-related learning outcomes

Knowledge

Has knowledge of the elements and structures of modern measurement and control systems as well as the basics of automatic control systems.
Has knowledge of the construction, principles of operation and programming of PLC logic controllers.
Has knowledge of the rules and basic structures of graphical programming in the NI LabVIEW environment.
Has knowledge of the interfaces and communication standards in measurement and control systems.

Skills

Is able to use advanced programming mechanisms in NI LabVIEW and available library programs.
Is able to choose the right PLC controller for the given control tasks.
Is able to develop control programs for PLC in ladder languages, function blocks and structured text.
Student can obtain information from literature and other sources, can integrate obtained information, interpret it, draw conclusions and justify opinions.

Social competences

A student is aware of the need for a professional approach to solved technical problems and taking responsibility for the proposed technical solutions.
Is able to formulate opinions on the basic challenges faced by modern measurement technology.
Can work in a group in the laboratory and perform team tasks.
Recognizes the legal, environmental and utilitarian aspects of measurements. Has a sense of responsibility for the presented measurement results.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures passing based on one written and/or oral examt from content of the lectures. The exam contains from 3 to 8 questions. The issues for the test (30) are sent to students by e-mail.
Passing threshold 50% of the sum of points for the test.
Grading scale: <50% - 2.0 (ndst); 50% to 59% - 3.0 (dst); 60% to 69% - 3.5 (dst +); 70% to 79% - 4.0 (db); 80% to 89% - 4.5 (db +); 90% to 100% - 5.0 (bdb).
The passing threshold may change depending on the results of the tests.

Laboratory. The final grade (FG) is determined on grades for reports, preparation for classes, behaviour and commitment during classes (CG) and final exam in the form of a self-implemented exercise or project (PG).
Grading scale:
5.0 for FG > 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.
Where FG – the weighted arithmetic mean: FG = 0.66CG + 0.34PG

Programme content

1. Graphical programming languages.
Integrated NI LabVIEW environment. Basics of programming in G language. Data types, local and global variables, operations on arrays and strings, control structures, state machine, event handling, queue management, hierarchical programming, subroutines and their synchronization, error handling, library functions, program diagrams. Programming PLCs in Ladder Diagram (LD), Functional Block Diagram (FBD) and Structured Text (ST) languages in Mitsubishi Electric GX Works 3 environment.
2. Elements of measurement and control systems.
The structure and organization of the measurement-control system. Classification and construction of signal acquisition systems. NI PXI, NI CompactDAQ hardware platforms, NI CompactRIO and NI MyRIO. Virtual measuring instrument. Industrial PLC controllers. Parameters and characteristics of sensors. Examples of sensors of electrical and non-electrical quantities. Smart sensors.
3. Interfaces in measurement and control systems.
Interface definition, serial and parallel interfaces, synchronous and asynchronous transmission, RS232 serial interfaces, I2C interface, SPI, UART, USB, IEEE 488 parallel interface, IEEE 488.2 (SCPI) standard.
4. Applications of FPGA circuits in measurement and control systems.
High-level programming of FPGAs. Real-time operating systems, response time to an event, clocking of processors and I / O circuits. Virtual machines, pipeline processing, parallelization of activities.
5. Fundamentals of control theory. The control process, the purpose of the control. Basic diagram of the automatic control system. Stability of linear automatic control systems. Quality of automatic control systems. Types of regulators and their characteristics. Selection of PID controller settings.

Teaching methods

Lecture: traditional multimedia presentation illustrated with a demonstration of the operation of the discussed systems and circuits and conversational lecture (with discussion elements).
Laboratory exercises: multimedia presentation with examples given on the blackboard and practical laboratory exercises according to the instructions.

Bibliography

Basic

1. Dariusz Świsulski, Komputerowa technika pomiarowa. Oprogramowanie wirtualnych przyrządów pomiarowych w LabVIEW, Agenda Wydawnicza PAK, 2005.
2. Marcin Chruściel, LabVIEW w praktyce, Wydawnictwo BTC, 2008.
3. Wiesław Taczała, Środowisko LabView w eksperymencie wspomaganym komputerowo, Wydawnictwo WNT: PWN, 2017.
4. Stanisław Flaga, Programowanie sterowników PLC w języku drabinkowym, Wydawnictwo BTC, 2010.
5. Sławomir Kacprzak, Programowanie sterowników PLC zgodnie z normą IEC61131-3 w praktyce, Wydawnictwo BTC, 2011.

Additional

1. Robert H. Bishop, LabVIEW Student Edition, National Instruments Inc.
2. Roman Mielcarek, Programowanie zagadnień transmisyjnych w sterownikach PLC : przewodnik do ćwiczeń laboratoryjnych, Wydawnictwo Politechniki Poznańskiej, 2019.
3. Robert Sałat, Krzysztof Korpysz, Paweł Obstawski, Wstęp do programowania sterowników PLC, Wydawnictwa Komunikacji i Łączności, 2014.

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3.0
Classes requiring direct contact with the teacher	49	2.0
Student's own work (preparation for tests, preparation for laboratory classes, preparation for exam, literature studies)	41	1.0