SYLLABUS

Name: ***Applications of Control Systems (AiRAu-SPI>SM2-ACS-19)***
Name in Polish:
Name in English: ***Applications of Control Systems***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma.polsl.pl/rau1/course/view.php?id=1179

Short description:

The aim of the course is to familiarize students with the principles of designing control systems on selected examples of applications of varying complexity, implemented using modern technical solutions. They will also gain practical skills in this area.

Description:

ECTS: 3
Total hours: 85 (contact 60h / individual work 25h)
Lecture: 30h
Laboratory: 30h
Student's individual work: 25h
Student's individual work includes: preparation for classes, development of results obtained during classes, writing a report, preparation for tests.

Lecture:
1. Objectives of a modern control and management system. Types of control. Defining the control task, inputs, outputs, disturbance, signal constraints, object model. Defining the control objective, selecting the control algorithm, control horizon. Classification of industrial processes.
2. Control and management system structure – functional and IT structure. Layers in the IT structure. Decomposition of the control task into partial, hierarchically related tasks. Satisfactory and optimal control. Control system design stages. Creation of a mathematical model. Model taxonomy.
3. Example – case study. Ideally mixed chemical reactor – assumptions, choice of state variables, state equations, optimal control, dynamic optimization horizon, control system structure, direct control system design, upper layer design, choice of controlled variables – uniqueness condition and invariance condition.
4. Simulation tests. Hardware-in-the-loop simulation.
5. Examples of control system applications: noise and vibration reduction in an active casing, semi-active suspension, electromagnetic mill, cutting process diagnostic system in a corrugator line.
6. Functional safety – fault-tolerant and fail-safe systems. Control system design principles, project documentation. System startup and application testing.
7. Discussion of the industrial wastewater treatment process based on the example of the Wastewater Treatment Plant in Grodków - applied equipment, process phases, control systems and algorithms.
8. Presentation of Siemens TIA Portal Software for control using the SIMATIC S7-1200 PLC and visualization using WinCC Professional for programming control and visualization of a pump station during laboratory classes.
9. Implementation of SCADA Server Redundancy for control and visualization of a backwash filter in the water treatment process using the iFIX Software Package.
10. National and international legal regulations regarding railway applications.
Railway systems as fail-safe systems.
11. EN 50128 standard as a basis for designing and programming railway traffic control systems. EN 50657 standard for designing software for railway rolling stock.
12. Principles of creating software for railway control and protection systems: organizational structure of the project group and the required SIL level
13. Functions and responsibilities of project group members. Design documentation, software testing, validation.

Laboratory:
1–2. Control system in grinding installation with electromagnetic mill (parts I and II)
3–4. Pumping station – TIA V18, Step 7, Operator panel (parts I and II)
5–6. Water treatment, backwash filter – iFIX, redundancy (parts I and II)

Bibliography:

1. Levine W.: Control System Applications, CRC Press, 1999, ISBN 9780849300547.
2. Secondary sources: Catalogs, manuals and instructions.

Learning outcomes:

• The student knows the principles of implementation of control algorithms in industrial control systems, K2A_W04.
• The student has knowledge of the use of modern tools supporting control systems, K2A_W11.
• The student knows the principles of creating complex multi-level control systems, K2A_W13.
• The student is familiar with the current state and the latest development trends of automation, K2A_W16 .
• The student is able to proficiently use appropriate programming tools to design complex automation systems and evaluate them, K2A_U08.
• The student is able to design and assemble the hardware layer of a control system as well as configure and program it, K2A_U20.
• The student is able to analyze market offers for design tasks, estimate the costs of designing and implementing a control system, K2A_U22.

Assessment methods and assessment criteria:

The lecture is assessed on the basis of tests after each of the three parts of the lecture.
The laboratory is assessed on the basis of the exercise performance and exercise report.
The final grade is the average of the grades from all tests and laboratory exercises.

The syllabus is valid from academic year 2025/2026 and its content cannot be changed during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	3	2020/2021-Z	