SYLLABUS

Name: ***PLC (AESAu>SI5PLC24)***
Name in Polish:
Name in English: ***PLC***

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/rau3/course/view.php?id=80440

Short description:

The objective of the course is to acquaint the students with issues concerning designing architectures and programs control for Programmable Logic Controllers (PLC). This includes: basic elements of PLC CPU architectures, construction of I/O modules, programming tools and languages used for programming of the PLC systems.

Description:

Students are supposed to have theoretical background in the field of fundamentals of digital circuits and assembler languages programming. This means the ability to practically apply knowledge from the following subjects: Theory of Logic Circuits, Computer Programming, Digital Circuits, Measurement Systems, Electronic Devices and Circuits, Peripheral Devices of Digital Systems.

Lectures:
-Introduction: What is a Programmable Logic Controller (PLC), how does it operate, how PLC can be programmed?
-A place and a role of PLCs in computer control and management systems.
-PLC hardware: Hardware architecture, modules, central processing unit, digital inputs, digital outputs, analog inputs, analog outputs – main features.
-International Standard IEC 61131: parts of the standard, IEC 61131-3, programming languages, common elements, literals.
-Data types and variables: Elementary and derived data types. Variables declaration.
-Graphical programming languages: LD and FBD – main features.
-Example of a programming tool – Step 7 TIA Portal: Creating a project. Configuration. Variables declaration. Editing a program in LAD and FBD.

Laboratory:
-Getting familiar with software tool Step7 TIA Portal. The software includes: project management program, program editor (LAD/FBD/STL), program for monitoring and modifying variables as well as PLC simulator (PLC SIMU). Learning programming languages for PLC in both graphical: LAD and FBD editions.
-Hardware configuration of a PLC: rail, power supplies, central processing units, input and output signal modules.
-Binary variables - way of addressing. Basic capabilities of LAD language for writing combination functions. Normally open and normally closed contacts and coils.
-Writing basic sequential functions - maintaining output signal state after control signal termination. Contact elements based implementation - with set or reset domination, flip-flop implementation - with set or reset domination, based on output elements i.e. S and R coils.
-Time measuring. Getting familiar with functions allowing time measurement - Timers. Application of the elements in the simple and more advanced control programs.
-Control function implementation as a structural program. Getting familiar with functions (Function). Main program, as a control program for calling functions.
-Numeral systems used in the PLCs, from binary notation, through BCD, up to ASCII notation.
-Basic arithmetic operation made on integer numbers - adding, subtracting, multiplication and dividing. Using of Enable Input (EN) and Enable Output (ENO).
-Using word domain copying function (MOVE) as an auxiliary function.
-Comparison of the integer numbers. Control with hysteresis and window comparator.
-Analog inputs and outputs – way of addressing, parameterization, reading and writing the values.
-Notation for floating point numbers (Floating Point) - real numbers (Real). Application area.
-Parameterized functions as a way to create universal procedures.

The number of hours of classes with direct participation of academic teachers or other persons teaching courses and students.
Contact hours:
Lecture: 15h
Laboratory: 30h

Student's own work:
Preparation for classes, tests: 10h
Preparation for laboratory exercises, tests: 10h
Preparation for computer tests on PLC: 10h
Laboratory reports: 10h

Total workload: 100h
Number of ECTS credits: 3

Bibliography:

1. SIMATIC S7-1200 Programmable Controller. System Manual. Siemens AG, 2021
2. SIMATIC S7-1200 Easy Book Manual. Siemens AG, 2012
3. SIMATIC S7-1500 Getting Started. Siemens AG, 2013

4. Programming Guideline for S7-1200/S7-1500. Siemens AG, 2013
5. John K-H, Tiegelkamp M.: IEC 61131-3: Programming Industrial Automation Systems, Springer-Verlag, Berlin Heidelberg, 2001
6. Bolton W.: Programmable Logic Controllers. (4th edition) Elsevier Newness. 2006
7. Tom Mejer Antonsen. Collection of Exercises for PLC Programming. 100 programming exercises from beginner to expert level. Books on Demand, 2023
8. Tom Meier Antonsen. PLC Controls with Ladder Diagram (LD). Books on Demand. 2021

Learning outcomes:

At the completion of the course, students:

- knowledge and comprehension of the functioning of PLCs and using them in automatic and informatics systems (K1A_W10, K1A_W11)
- knowledge and comprehension of programming languages with particular emphasis on LD language (K1A_W10)
- are able to applying programming tools for creation of PLC applications (K1A_U1, K1A_U2, K1A_U5)
- are able to design control systems based on PLC applications (K1A_U6, K1A_U8, K1A_U10)
- can analyze properties of written control systems based on PLC (K1A_U2, K1A_K1)
- can set parameters of a PLC system to achieve a given objective (K11A_U2, K1A_K1)

Assessment methods and assessment criteria:

The final grade is determined after the student has obtained at least 2.5 points for each test in theory and practical classes (it is a necessary condition for the subject) and grades for the laboratory exercises assessed. On this basis, the average of points obtained for all laboratory exercises and lecture tests is calculated, according to the following rules:
[3.00 - 3.25) - 3.0
[3.25 - 3.75) - 3.5
[3.75 - 4.25) - 4.0
[4.25 - 4.75) - 4.5
[4.75 - 5.00] - 5.0

The syllabus is valid from the 2024/25 academic year, 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	2024/2025-Z	