COURSE DESCRIPTION CARD - SYLLABUS

Course name
Programmable logic controllers and SCADA systems [S2Elenerg1>PSLiS]

Course

Field of study
Electrical Power Engineering

Year/Semester
2/3

Area of study (specialization)
Smart Grids

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge - the student beginning this course should have basic knowledge of the basics of digital electronics, programming and automation, should also have the ability to obtain information from indicated sources and have the willingness to cooperate in a team. Skills - the ability to effectively self-educate in the field related to the chosen field of study; the ability to make appropriate decisions in solving simple tasks and formulating problems in the field of PLC programming. Competences - the student is aware of extending his competences, demonstrates readiness to work in a team, ability to comply with the rules binding during lectures and laboratory classes.

Course objective

To acquire knowledge and skills about real-time systems and programmable logic controllers (PLCs), to become familiar with PLC architecture, to become familiar with PLC programming languages, to acquire the ability to operate and configure PLCs, and to develop and implement algorithms that perform selected functions, with particular emphasis on industrial applications. Learning concepts of SCADA management and data acquisition systems. Acquire practical skills of creating SCADA applications.

Course-related learning outcomes

Knowledge:
1. the student has elementary knowledge of construction, operation principle and selection of plcs (including simulated ones) cooperating with scada visualization and control systems.
2. the student should have knowledge of selected programming languages used to implement the developed control algorithms.
3. the student should know basic concepts connected with designing, configuration and operation of hmi (human machine interface) and scada systems.

Skills:
1. the student will be able to apply his knowledge in the construction and principles of operation of plcs and peripheral devices.
2. the student will be able to develop control algorithms in selected plc programming languages.
3. the student will be able to program various hmi interfaces and configure them.

Social competences:
1.the student understands the importance of knowledge in solving problems and improving professional, personal and social competences.
2.the student is aware that in technology knowledge and skills become obsolete very quickly.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
The knowledge acquired during the lecture is assessed through a written test (midterm) held during the penultimate lecture. The test consists of open-ended and multiple-choice questions, scored depending on the level of difficulty. Passing threshold: 50% of the total points. The course content discussed during the lectures is available as a PDF file on the eKursy platform.

Laboratory:
The skills acquired during the laboratory sessions are assessed based on reports from computer-based and physical exercises. These include writing code to control the considered device/machine, configuring the workstation, running real-time models, integrating them with the object, conducting scenario-based tests, and interpreting the results. The report should include the assumptions discussed during the introduction and provided on the eKursy platform. The laboratory component is considered passed after obtaining at least 50% of the points from the laboratory part.

Programme content

The lecture and laboratory programme covers PLCs and programming languages, network communications, HMIs, servo drives, control systems and SCADA and DCS systems.

Course topics

Lecture:The definition of a PLC and its use in industrial applications, PLC programming languages, timer and counter support in PLCs including the so-called fast counters (dedicated to work with various types of encoders), interrupt system support in PLCs, pulse output support in PLCs, closed-loop control systems (regulator algorithms in PLCs). Timers and counters in PLCs including the so called fast counters (dedicated to work with various types of encoders), interrupt system operation in PLCs, impulse outputs operation in PLCs, closed-loop control systems (regulator algorithms in PLCs), servo drives operation control, HMI (Human Machine Interface) based on PC platforms as well as dedicated hardware platforms (e.g. operator panels), SCADA systems (definition, PLC programming languages), SCADA systems (definition, PLC programming languages), HMIs (Human Machine Interface) based on PC platforms as well as dedicated hardware platforms (e.g. HMIs). SCADA systems (definition, requirements, tools), network communication in SCADA systems, network topologies and transmission media used in control systems. Visualization methods used in PLC-based control systems. Creating
screens and sub-screens and navigating between them. Configuration of communication with external devices, creating synoptic screens, defining variables, configuring alarms, charts (trends), recording events - logs, elements of programming, securing the system from unauthorized access (configuring
users and the system of authorization), handling events, reports, keyboard shortcuts, working with real industrial controller, and learning about other selected elements of SCADA system.

Laboratory:
Introduction to the class. Discussion of health and safety rules of working in Room 720.
Programming with Structured Text (ST). Programme Illustrating the operation of a liquid tank.
Software illustrating the principle of a mixer, using ST language and an embedded controller simulator.
Visualisation of tank operation - development of user interface for process control.
MappCockpit tool for commissioning and diagnostics of a single axis servo drive
Lab 225MC
Introduction to the class. Discussion of health and safety rules working in the laboratory. Drive solutions powered by inverters frequency converters
Configuration and diagnostics of an industrial servo drive with motor PMSM in the AS environment: Familiarisation with the test bench and the B&R Automation Studio (AS) development environment (appendix: B&R environment); Creation of a project in the AS environment - communication with the controller; Configuration of the test bench components in the project, definition of the servo drive axis, Start-up of the axis using the TEST tool (appendix: B&R environment), Control of the axis using the SingleAx.ST program.
Testing the operation of industrial servo drives in axis synchronisation mode Position of the axes: Familiarisation with the test bench, Introduction and configuration of the test bench components in the project, Definition of the servo drive axes, Start-up and configuration of the axes using the TEST tool (appendix: Environment R&D environment), Control of axes in synchronisation mode - Master/Slave.
Programming of the model lift control system: Familiarising yourself with the test bench, Configuring the VLT Automation Drive inverter to work with the external control system, Checking the correct connection of control signals and sensors to the control system, creating a new project in AS, Configuring the I/O and assigning variables to them, writing a programme implementing the basic control modes of the lift.
Visualisation of the basic control quantities on the HMI: Developing a project in AS based on the instructor's guidance. Running the project on the HMI panel Controlling the project using the HMI panel.
Visualising the operation of an industrial servo drive with a PMSM motor on an HMI panel, Developing a project in AS to visualise the movement of a single axis of the servo drive, Running the project on an HMI panel, Controlling a single axis using an HMI panel.
Visualisation of the model lift control system on the HMI panel: Development of a project in AS to visualise the movement of a model lift, Commissioning of the project on an HMI panel, Control of a single axis using an HMI panel.
SCADA systems using Aveva In Touch: Design of application for acquisition, visualisation and processing of measurement data, Development of measurement systems, control, acquisition of results and their analysis

Teaching methods

Lecture: multimedia presentation (including: figures, photos, animations, films) supplemented with examples given on the board.
Project: working in teams, using provided instructions and tools that enable students to perform tasks at home developing project documentation.

Bibliography

Basic
1. Dokumentacja techniczna wybranych sterowników PLC oraz serwonapędów
2. Kwaśniewski J., Sterowniki PLC w pracy inżynierskiej, PTC, Kraków 2008.
3. Legierski T., Programowanie sterowników PLC, WPKJS, Gliwice 1998.
4. Zieliński T.P., Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań, Wydawnictwa Komunikacji i Łączności, Warszawa 2009.
5. Sałat R., Korpysz K., Obstawski P., Wstęp do programowania sterowników PLC, WKŁ,2014.
Additional
1. Normy dotyczące języków programowania sterowników PLC
2. Dokumentacja standardu PLC Open Motion Control
3. Internet: specialist subject literature, datasheets, standards.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50