SYLLABUS

Name: ***Programming of Industrial Controllers (InfAAu>SI6PoIC19)***
Name in Polish:
Name in English: ***Programming of Industrial Controllers***

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://platforma2.polsl.pl/rau2/course/view.php?id=270

Short description:

The aim of the course is to present the issues of construction and programming of freely programmable controllers used in OT systems operating in industry and to highlight the theoretical and practical problems that may be encountered in this process.
The lecture will help future engineers configure PLC controllers, design and develop their software, and design distributed IT systems using them. An additional goal of the course is to enhance the soft skills necessary for engineering work.
Topics covered include the role, design, and programming of controllers, as well as their role in an interdisciplinary industrial environment, both traditionally structured and aligned with the Industry 4.0/5.0 concept.

Description:

ECTS: 2
Total Hours: 30 (30 contact hours / 30 student's own work)
Lecture: 15h
Laboratory: 15h
Student's own work: preparation for classes, preparation for test, reading the literature, independent study of issues, preparation of reports.
Form of classes: contact
The lecture
• Basic concepts: industrial information system, centralized systems, distributed systems, time determinism, real-time systems and their types.
• Freely Programmable Controller: hardware definition and examples, overview of modern solutions, purpose, idea of operation and purpose of existence.
• Controller cycle: definition and examples, cycle elements, types of cycles, discussion of the individual stages of the cycle, scan duration.
• Description of the hardware structure of devices: contemporary hardware structures, processors, memories, central units, coprocessors, racks, cassettes, modules, power supply.
• Hardware and software configuration of controllers: the concept of configuration, selection of configuration to the system requirements.
• Description of the phenomena occurring in each of the controller elements: discussion of the phenomena at the interface between the central unit and the coprocessor, cooperation with a computer network, cooperation and other controllers.
• Memory organization: memory zones, data types, predefined variables, system zones, variable allocation, block instances, types of addressing and types of memory access.
• Overview of programming languages: discussion of text and graphic languages, including: IL, LD, FBD, ST, SFC, CFC; discussion of ladder languages using logic flow-controlled commands.
• IEC 61131 overview: coverage of parts 1-10 with particular emphasis on part 3.
• Programming elements: common elements shared between different languages, addressing and inter-module communication, language conversion.
• Selected languages: Overview of the basic instructions for Siemens/Simatic, GEFanuc/VersaMax, PACSystems, Moeller XSystem, Beckhoff, and others with brief usage examples for each instruction.
• Overview of sample programs for various platforms: examples of code that performs specific tasks, discussing the practical problem being solved, discussing the method of the presented solution and alternative solutions.
Lab
• Overview of development tools: presentation of contemporary development environments for various hardware platforms with an overview of the most important functions and showing examples on real projects.
• Implementation of practical tasks on real devices, taking into account the work of students in a group and devices in the system, together with the use of executive devices.
• Tasks are elements of tasks that occur in the implementation of real applications or are specially prepared to emphasize the important issues of PLC programming.

Bibliography:

Subject-oriented monographs (available from the Silesian University of Technology Library https://opac.bg.polsl.pl/):
* Selected issues of designing industrial IT systems / Piotr Gaj. - Gliwice: Silesian University of Technology Press, 2016.
* Analysis of information flow in computer industrial networks / Andrzej Kwiecień; The Silesian Technical University. Institute of Computer Science. - Ed. 2 ext. - Gliwice: Silesian University of Technology Publishing House: Jacek Skalmierski's Computer Laboratory Publishing House, cop. 2013.

Scientific articles on the subject (available in the e-resources of the Silesian University of Technology https://www.bg.polsl.pl/ebazy/listaebaz_s3.html)

Thematic literature available online.
IEEE Xplore: https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=programming%20of%20industrial%20controllers
Springerlink: https://link.springer.com/search?query=programming+of+industrial+controllers

Literature:
[1]. Piotr Gaj, “Wybrane zagadnienia projektowania informatycznych systemów przemysłowych”, Studia Informatica, Gliwice 2016

[2]. Relevant papers published by IEEE Transactions on Industrial Informatics (ieeexplore.ieee.org)
[3]. Kevin Collins, PLC Programming for Industrial Automation, November 14, 2006, ISBN-10: 1846854962, ISBN-13: 978-1846854965
[4]. Gary Dunning, Introduction to Programmable Logic Controllers, 2nd edition, Delmar (www.delmar.com) ISBN 0-7668-1768-7
[5]. William Bolton, Programmable Logic Controllers, Newnes, 2006
[6]. Kasprzyk Jerzy, Programowanie sterowników przemysłowych, ISBN 9788363623241, WNT, Warszawa 2014
[7]. Roman Mielcarek „Programowanie Sterowników PLC – przewodnik do ćwiczeń laboratoryjnych" Wydawnictwo Politechniki Poznańskiej, 2012
[8]. Kacprzak S.: Programowanie sterowników PLC zgodnie z normą IEC61131-3 w praktyce. BTC 2011.
[9]. Król Artur, Moczko-Król Joanna "S5/S7 Windows. Programowanie i symulacja sterowników PLC firmy Siemens", Nakom
[10]. Dworak Paweł, Pietrusewicz Krzysztof, „Programowalne Sterowniki Automatyki PAC", Nakom
[11]. Sałat Robert, Korpysz Krzysztof, Obstawski Paweł „Wstęp do programowania sterowników PLC", WKIŁ 2010
[12]. Kwaśniewski Janusz.: Sterowniki PLC w praktyce inżynierskiej. BTC 2008.
[13]. Kwaśniewski Janusz „Programowalny sterownik SIMATIC S7-300 w praktyce inżynierskiej", BTC
[14]. Kwaśniewski Janusz, „Programowalne sterowniki przemysłowe w systemach sterowania" Wydawnictwo AGH 1999.

Additional literature:
[1]. Andrzej Kwiecień: „Analiza przepływu informacji w komputerowych sieciach przemysłowych"; Studia Informatica z. 22, Gliwice 2002 lub WPKJS Gliwice
[2]. Wilamowski, B.M. and Irwin, J.D. The Industrial Electronics Handbook, Second Edition - Five Volume Set, Taylor & Francis 2011, USA
[3]. Wilamowski, B.M. and Irwin, J.D. Fundamentals of Industrial Electronics, CRC Press 2011, USA
[4]. Wilamowski, B.M. and Irwin, J.D. Industrial Communication Systems, CRC Press 2011, USA
[5]. Kwiecień Roman „Komputerowe systemy automatyki przemysłowej" Helion 2012
[6]. Bogdan Broel-Plater, „Układy wykorzystujące sterowniki PLC – projektowanie algorytmów sterowania", PWN 2008
[7]. „Programowalne sterowniki PLC w systemach sterowania przemysłowego", Politechnika Radomska 2001
[8]. Jerzy Pasierbiński, T. Jegierski, „Programowanie sterowników PLC"
[9]. Andrzej Maczyński, „Sterowniki programowalne PLC. Budowa systemu i podstawy programowania"
[10]. Zbigniew Seta, „Wprowadzenie do zagadnień sterowania. Wykorzystanie programowalnych sterowników logicznych PLC."
[11]. Włodzimierz Solnik, Zbigniew Zajda "Sieci przemysłowe Profibus DP i MPI w automatyce", Wyd. Politechniki Wrocławskiej

Learning outcomes:

Knows and understands the structure, architecture, and operation of industrial controllers, their role in systems, and is familiar with typical controller programming languages at the engineering level. Knows the principles of designing and implementing simple IT systems using controllers: K1A_W10
Knows and understands the detailed aspects of algorithms, programming, code design, and modeling of systems using industrial controllers and the controllers themselves: K1A_W11
Can build simple industrial IT systems using controllers, including hardware and tool selection, as well as code design and development: K1A_U16
Can understand and formulate technical and operational specifications for simple industrial IT systems, including hardware, system software, and application functionalities: K1A_U20

Assessment methods and assessment criteria:

According to SUT regulation, lecture attendance is optional (however
highly recommended).
The learning outcomes of the lecture are verified in the laboratory. To complete the laboratory exercises, the knowledge provided successively during the lecture series is necessary.
Verification of learning outcomes on the basis of reports from laboratory exercises and activity in the classroom.
Completion of the course based on laboratory reports and a test. Component grades are the laboratory grade and the test grade.
The laboratory grade is the weighted mean calculated from all laboratory exercises. It can be adjusted by student activity assessed individually by observation and oral responses.
Lecture grades are based on a written test. The test may be written or online. Students must achieve a grade of at least 3.0 out of a maximum of 5.0. There will be one test at the end of the semester. The test may be retaken once during the exam period. Exemptions from the test may be granted based on individual student performance.
The final grade is the weighted mean of the component scores.
Final course grade (FCG) is calculated as follows:
FCG = 0,75 *FG6 + 0,25*test
Completion of a course when all the following conditions are met:
* 100% attendance at laboratory classes,
* the final grade (FC6) is greater than or equal to 3.0,
* the cycle requirements, if any.
The syllabus is valid from the academic year 2025/2026, and its content is not subject to change during the semester.

Course credits in various terms:

Informatics, full-time first degree engineering studies 7 sem. (InfAAu-SI7)

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	2	2020/2021-L	