(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: PROGRAMMING OF INDUSTRIAL CONTROLLERS	**2. Course code: SSI_PSP**
3. Validity of course description: 2018/2019	
4. Level of studies: BSc program 1st cycle	
5. Mode of studies: intramural studies	
6. Field of study: INFORMATICS	(FACULTY SYMBOL) AEI
7. Profile of studies: COMPUTER SCIENCE	
8. Programme:	
9. Semester: 6	
10. Faculty teaching the course: Institute of Informatics (Rau2)	
11. Course instructor: dr inż. Piotr Gaj	
12. Course classification:	
13. Course status: compulsory	
14. Language of instruction: Polish	

15. Pre-requisite qualifications:

- Fundamentals of Computer Science
- Computer Networks
- Basics of Programming

16. Course objectives:

The aim of the course is to present the programmable controllers used in control and IT systems working in industry and to highlight the theoretical and practical issues of programming.
The lecture will make it easier for the future engineer to configure programmable logic controllers (PLC), to design and create their software as well as to design distributed systems where the main nodes are programmable controllers.

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knowledge on construction, operation and programming of PLC class controllers	Laboratory exercise	Lecture, Laboratory	K1A_W10 K1A_W22
2.	The role of PLC controllers in industrial computer systems	Laboratory exercise	Lecture	K1A_W11 K1A_W18
3.	The issues of interactions of cyber/digital devices with physical objects	Laboratory exercise	Lecture	K1A_W17
4.	To solve a practical problem related to the usage of industrial controllers	Laboratory exercise	Laboratory	K_U01 K_U02 K_U03 K_U05
5.	To select hardware components and programming languages of programmable industrial controllers for a given task or section of a task.	Laboratory exercise	Laboratory	K_U16 K_U17
6.	To use the facilities and capabilities of devices and their programming languages in a practical way to create a system solution and its maintenance	Laboratory exercise	Laboratory	K_U14 K_U20 K_U21 K_U23 K_U29 K_U30
7.	To understand the important role of IT specialist in creating systems based on industrial controllers.	Laboratory exercise	Lecture	K_K01 K_K03

8.	To work individually and in a team	Laboratory exercise	Laboratory	K_K02
9.	To create a solution taking into account non-technical criteria	Laboratory exercise	Laboratory	K_K05

18. Teaching modes and hours

Lecture: 15 h

Laboratory: 15 h

19. Syllabus description:

Semester 6:

Lecture:

Basic concepts: industrial IT system, centralized systems, distributed systems, time determinism, real-time systems and their types.
Programmable Controller: hardware definition, review of contemporary solutions, purpose, idea of operation, purpose of existence, and examples.
Controller cycle: definition, elements of the cycle, types of cycles, discussion of individual stages of the cycle, duration of the cycle, and examples.
Description of the hardware construction of devices: modern hardware constructions, processors, memories, central units, coprocessors, racks and cassettes, modules, power supply.
Hardware and software configuration of controllers: concept of configuration, selection of configuration to system requirements.
Description of phenomena occurring in each of the controller's elements: discussion of phenomena at the interface between the central unit and the coprocessor, cooperation with the computer network, cooperation and other drivers.
Memory organization: memory zones, data types, variables, system zones, variable allocation, block instances, types of addressing and types of memory access.
Discussion 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.
Discussion of the IEC 61131 standard: discussion of Parts 1-9 with particular reference to Part 3.
Programming elements: common elements shared between different languages, addressing and inter-module communication, language conversion.
Overview of the commands list: discussion of the basic instructions for the GEFanuc / VersaMax / GE IP, PACSystems, Moeller XSystem, Beckhoff, and other platforms with examples.
Discussing examples of programs for various platforms: examples of code that performs specific tasks, discussion of a practical problem being solved, discussion of the method of the presented solution and alternative solutions.

Laboratorium

Discussion of programming tools: presentation of contemporary development environments for various hardware platforms together with a discussion of the most important functions and showing examples on real projects.
Implementation of practical tasks on real devices including the work of students in the groups and lab systems.
Tasks become elements of real solutions being parts of real applications or are specially prepared to highlight the important problems of PC programming.

20. Examination: none

21. Primary sources:

[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.

22. Secondary sources:

[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

[12]. Mystkowski Arkadiusz, „Sieci przemysłowe PROFIBUS DP i PROFINET IO"

[13]. Zeszyty Naukowe Politechniki Śląskiej seria „Studia Informatica" ISSN 0208-7286

[14]. Archives of Control Sciences ISSN 1230-2384

[15]. Zeszyty Naukowe AGH seria Automatyka ISSN 1429-3447

[16]. Zeszyty Naukowe AGH seria Computer Science ISSN 1508-2806

[17]. Relevant papers published by LNCS, CCIS (link.springer.com)

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/12
2	Classes	/
3	Laboratory	15/20
4	Project	/
5	BA/ MA Seminar	/
6	Other	/
	Total number of hours	30/32

24. Total hours: 62

25. Number of ECTS credits: 2

26. Number of ECTS credits allocated for contact hours: 1

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

ECTS calculation:

- Contact hours 30h, including:
  - lectures attendance: 15h,
  - lab attendance: 15h
- Workload hours 32h, including:
  - preparation to lab classes: 7h
  - literature review: 5h
  - data & program preparation, commissioning, verification: 12h
  - report preparation: 8h

Approved:

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(date, Instructor's signature) (*date , the Director of the Faculty Unit signature)*