1. Course title: PROGRAMMING OF INDUSTRIAL CONTROLLE
RS
2. Course code: SSI_PSP
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:

<table>
<thead>
<tr>
<th>Nr</th>
<th>Learning outcomes description</th>
<th>Method of assessment</th>
<th>Teaching methods</th>
<th>Learning outcomes reference code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Knowledge on construction, operation and programming of PLC class controllers</td>
<td>Laboratory exercise</td>
<td>Lecture, Laboratory</td>
<td>K1A_W10 K1A_W22</td>
</tr>
<tr>
<td>2.</td>
<td>The role of PLC controllers in industrial computer systems</td>
<td>Laboratory exercise</td>
<td>Lecture</td>
<td>K1A_W11 K1A_W18</td>
</tr>
<tr>
<td>3.</td>
<td>The issues of interactions of cyber/digital devices with physical objects</td>
<td>Laboratory exercise</td>
<td>Lecture</td>
<td>K1A_W17</td>
</tr>
<tr>
<td>4.</td>
<td>To solve a practical problem related to the usage of industrial controllers</td>
<td>Laboratory exercise</td>
<td>Laboratory</td>
<td>K_U01 K_U02 K_U03 K_U05</td>
</tr>
<tr>
<td>5.</td>
<td>To select hardware components and programming languages of programmable industrial controllers for a given task or section of a task.</td>
<td>Laboratory exercise</td>
<td>Laboratory</td>
<td>K_U16 K_U17</td>
</tr>
<tr>
<td>6.</td>
<td>To use the facilities and capabilities of devices and their programming languages in a practical way to create a system solution and its maintenance</td>
<td>Laboratory exercise</td>
<td>Laboratory</td>
<td>K_U14 K_U20 K_U21 K_U23 K_U29 K_U30</td>
</tr>
<tr>
<td>7.</td>
<td>To understand the important role of IT specialist in creating systems based on industrial controllers.</td>
<td>Laboratory exercise</td>
<td>Lecture</td>
<td>K_K01 K_K03</td>
</tr>
</tbody>
</table>
To work individually and in a team | Laboratory exercise | Laboratory | K_K02
---|---|---|---
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:
   [2]. Relevant papers published by IEEE Transactions on Industrial Informatics (ieeexplore.ieee.org)
   [5]. William Bolton, Programmable Logic Controllers, Newnes, 2006
   [7]. Roman Mielcarek „Programowanie Sterowników PLC – przewodnik do ćwiczeń laboratoryjnych” Wydawnictwo Politechniki Poznańskiej, 2012
   [10]. Dwojak Paweł, Pietruszewicz Krzysztof, „Programowalne Sterowniki Automatyki PAC”, Nakom
   [13]. Kwaśniewski Janusz „Programowalny sterownik SIMATIC S7-300 w praktyce inżynierskiej”, BTC
22. Secondary sources:

[1]. Andrzej Kwiecień: „Analiza przepływu informacji w komputerowych sieciach przemysłowych“, Studia Informatica z. 22, Gliwice 2002 lub WPKJS Gliwice
[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
[7]. „Programowalne sterowniki PLC w systemach sterowania przemysłowego“, Politechnika Radomska 2001
[8]. Jerzy Pasierbński, 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. “
[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

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

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:

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