### COURSE DESCRIPTION

<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>He knows the software structure and its functional elements</td>
<td>SP, CL</td>
<td>WT, WM</td>
<td>K_W3/3; W7/2; W9/1</td>
</tr>
<tr>
<td>2.</td>
<td>He knows the rules of the program code optimization.</td>
<td>SP, CL</td>
<td>WT, WM</td>
<td>K_W3/2</td>
</tr>
<tr>
<td>3.</td>
<td>He has expertise in the diagnosis controllers.</td>
<td>SP, CL</td>
<td>WT, WM</td>
<td>K_W18/2; W22/1</td>
</tr>
<tr>
<td>4.</td>
<td>Able to determine the appropriate structure and language, depending on the type of task.</td>
<td>SP, CL, L</td>
<td></td>
<td>K_U1/3; U18/1</td>
</tr>
<tr>
<td>5.</td>
<td>He can diagnose the cause of the controller fault and run it again.</td>
<td>SP, CL, L</td>
<td></td>
<td>K_U1/3</td>
</tr>
<tr>
<td>6.</td>
<td>Can independently make decisions regarding the optimal structure of the program.</td>
<td>CL, OS</td>
<td>L</td>
<td>K_K1/1; K2/1; K4/2; K6/1</td>
</tr>
<tr>
<td>7.</td>
<td>Able to present and defend the proposed solution.</td>
<td>OS</td>
<td>L</td>
<td>K_K1/1; K5/1; K6/1 K7/1</td>
</tr>
</tbody>
</table>

18. **Teaching modes and hours**

Lecture 30 / BA/MA Seminar 0 / Class 0 / Project 0 / Laboratory 30

19. **Syllabus description:**

**Semester**: 

**Lecture.** This subject is an extension and continuation of the general subject of "Controllers and industrial networks." It is
assumed, therefore, a basic ability to use dedicated controllers and software packages for them. As part of this course, students have to meet these advanced packages (Step7, RSLogix5000), and more complex programming constructs for handling errors and other hardware interrupts. Great emphasis is placed on understanding the principles of cyclical performance of most programs in the controller and the consequences of this fact. An important aspect is also to present the principles of proper structuring of the control program, which has an important impact on the optimization of the code. Proper structuring of the program will not be possible without the knowledge of the opportunities available in the various software packages. Therefore be discussed in detail the structure of the available elements. These are issues of merger, the order of execution and the effective exchange of data. As one of the aspects of effective exchange of information to be understood process variables collection in blocks or data structure. Subject includes familiarization with the issue of the PLC diagnostics and code optimization program with a particular emphasis on the development of programs in STL language during laboratory classes. Program includes also a discussion of the internal registers of the processor in the controller and that use indirect addressing techniques to manipulate the data tables, including multi-dimensional arrays. Certain library functions are describes created by the producers with an emphasis on the blocks used to control (PID blocks). Content of the program are covered in the following topics of lectures:

1. General information about the PLC-programming principle and the driver, a review of the current offer leading manufacturers
2. Programming and diagnostics Simatic S7-300/400 - Package Step 7
4. Selected commands of text languages IL and STL (conditional jump instructions, shift and rotate operations, floating-point arithmetic).
5. Data types (elementary and complex), variable declarations, matrix operations. Program organization, depending on the destination, functional blocks, software, standard libraries.
6. Indirect addressing of data structures in the controller (indicators, registers, registers operations).
7. System functions in Siemens and Allen-Bradley controllers, error handling.
8. Status word of PLC processor and its use in control tasks.
9. Principles of designing a control system based on PLC, I/O modules calibration of analog channels
10. PID control systems PLC - configuration examples.
11. PID control systems PLC - examples of implementation.
13. Advanced control algorithms
14. Trends in the development of control systems

The laboratory. Laboratory schedule is closely aligned with the lectures. Examples illustrating the general principles of programming, optimization and diagnostics are presented.

1. Programming and code optimization in LD (Ladder Diagram language) for Allen-Bradley controllers. Support for binary signals, analysis of the various possible solutions to the same problem.
2. Programming in FBD (Function Block Diagram) for Allen-Bradley controllers. The implementation of the control program supports the most continuous signals. The use of simulation capabilities available in this language.
3. Diagnosis of Allen-Bradley controllers. Working with the program prepared by instructor to diagnose and repair errors that cause the controller to stop.
4. PID programming in Allen-Bradley controllers. Application of PID control program and test its performance, taking into account the specific units of the individual parameters of the algorithm.
5. Simatic S7 Programming Part I. Advanced hardware configuration of various CPU modules, archiving and downloading projects.
7. Simatic S7 Programming Part III. The use of indirect addressing for controllers. Creating queues and stacks of data.
9. PID programming in Simatic S7 controllers. Configuration and commissioning using a loop library blocks FB42 FB41 and PID controllers with simulated dynamic objects.

20. Examination: semester … no

21. Primary sources:
1. Trybus L. Regulatory wielofunkcyjne WNT, Warszawa 1992
3. Instrukcja i materiały szkoleniowe poszczególnych producentów (w wersji elektronicznej).

22. Secondary sources:

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>30/10</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>/</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>30/20</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>5/5</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>65/35</td>
</tr>
</tbody>
</table>

24. Total hours:100

25. Number of ECTS credits: 3

26. Number of ECTS credits allocated for contact hours: 2

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

26. Comments:

Approved:

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