1. Course title: PROGRAMMABLE CONTROLLERS

2. Course code

3. Validity of course description: 2017/2018

4. Level of studies: 2nd cycle of higher education

5. Mode of studies: intramural studies

6. Field of study: MACROCURSE (FACULTY SYMBOL) RAU

7. Profile of studies: All-academic

8. Programme: AUTOMATIC CONTROL

9. Semester: 2

10. Faculty teaching the course: Institute of Automatic Control, RAu1


12. Course classification: common subjects

13. Course status: compulsory

14. Language of instruction: English

15. Pre-requisite qualifications: Fundamentals of computer programming, Introduction to electronics, Control fundamentals, Computer networks, Operating systems, Microprocessor systems, Measurement Systems. It is assumed that student starting this course has ability to use computers and professional engineering software. He/she knows basics of computer science, industrial measurements, digital control and PID algorithm, microprocessor systems and electro-mechanics.

16. Course objectives: The aim of the course is to present fundamentals on programmable controllers, their use, maintenance and programming. During the course students have an opportunity to make acquaintance with equipment and programming tools of manufacturers leading in PLC technology. Also principles of designing control systems based on PLC and HMI are presented.

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 and comprehension of the functioning of PLCs and using them in automatic systems</td>
<td>EP</td>
<td>WM</td>
<td>K_W18</td>
</tr>
<tr>
<td>2.</td>
<td>Knowledge and comprehension of basic programming languages</td>
<td>EP</td>
<td>WM</td>
<td>K_W18</td>
</tr>
<tr>
<td>3.</td>
<td>Skills in applying programming tools for PLCs and creation of PLC applications</td>
<td>CL, PS</td>
<td>L</td>
<td>KU_18</td>
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<tr>
<td>4.</td>
<td>Ability to design control systems based on PLCs</td>
<td>OP</td>
<td>P</td>
<td>KU_23</td>
</tr>
<tr>
<td>5.</td>
<td>Understanding of the necessity for life-long learning, ability to inspire and organize the learning process of other people</td>
<td>CL</td>
<td>L</td>
<td>K_K01</td>
</tr>
</tbody>
</table>

18. Teaching modes and hours

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

19. Syllabus description:

Semester:

Lecture:

Introduction: What is a Programmable Logic Controller (PLC), how does it operate, how PLC can be programmed? A place and a role of PLCs in computer control and management systems.

International Standard IEC 61131: parts of the standard, IEC 61131-3, programming languages, common elements, literals.

Data types and variables: Elementary and derived data types. Variables declaration.

Graphical programming languages: LD and FBD – main features.

Example of a programming tool – RS5000: Creating a project. Configuration. Variables declaration. Editing a program in LD.

Example of a programming tool – Step 7: Creating a project. Configuration. Variables declaration. Editing a program in LAD and FBD.

Program organization units: Programs, function blocks, functions. Standard FFBs. Derived FFBs. Creating a derived FB.


Implementation of PID in PLCs: Algorithm, problems to be solved: man/auto bumpless switch over, anti-windup, examples of implementation. PLC hardware: Hardware architecture, modules, central processing unit, digital inputs, digital outputs, analog inputs, analog outputs – main features. Redundancy, hot standby CPU.

Programming HMI (Human Machine Interface): Operator panels, Example of HMI project creation. Applications of PLCs in automation and control.

Principles of designing projects, safety of implementation, examples of applications.

Lab (Laboratory):
1. Programming and maintenance of a PLC (RS5000). Basic functions of a programming tool – project creation, controller configuration, programming simple tasks in LD.
2. Programming Simatic S7-300 (Step7). Basic functions of a programming tool – project creation, controller configuration, programming simple tasks in graphical languages.
6. HMI application. Programming an operator panel for the application created in the previous exercise.

20. Examination: yes

21. Primary sources:

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>0 / 0</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>30 / 10</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>30 / 10</td>
</tr>
<tr>
<td>5</td>
<td>BA/MA Seminar</td>
<td>0 / 0</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>10 / 0</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>100 / 30</td>
</tr>
</tbody>
</table>

24. Total hours: 130

25. Number of ECTS credits: 4

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

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 2

28. Comments:

Approved:

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