(*faculty stamp*)

Z1-PU7	WYDANIE N1	Strona 1 z 2

COURSE DESCRIPTION

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: MACROCOURSE	(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	
11. Course instructor: Jerzy Kasprzyk, Dsc. Eng.	
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:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knowledge and comprehension of the functioning of PLCs and using them in automatic systems	EP	WM	K_W18
2.	Knowledge and comprehension of basic programming languages	EP	WM	K_W18
3.	Skills in applying programming tools for PLCs and creation of PLC applications	CL, PS	L	KU_18
4.	Ability to design control systems based on PLCs	OP	P	KU_23
5.	Understanding of the necessity for life-long learning, ability to inspire and organize the learning process of other people	CL	L	K_K01

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.
Textual programming languages: Programming in STL in Step 7. Programming in ST in Unity Pro.

Program organization units: Programs, function blocks, functions. Standard FFBs. Derived FFBs. Creating a derived FB.
Sequential Function Chart: Steps, transitions, rules of evolution, alternative and simultaneous sequences, actions, step-action association. Example of implementation.
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.

Laboratory:

1. Programming and maintanance 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.
3. Programming in STL (Step7). Programming simple tasks in the textual language.
4. Programming in ST (Unity Pro).
5. Sequential Function Chart (SFC). Programming sequential control tasks for a batch reactor.
6. HMI application. Programming an operator panel for the application created in the previous exercise.

20. Examination: yes

21. Primary sources:

1. John K-H, TiegelKamp M.: *IEC 61131-3: Programming Industrial Automation Systems*, Springer-Verlag, Berlin Heidelberg, 2001.
2. Bolton W.: *Programmable Logic Controllers.* (4th edition) Elsevier Newness, 2006.
3. Manuals of manufacturers (electronic).

22. Secondary sources:

1. Kasprzyk J.: *Programowanie sterowników przemysłowych*. WNT, Warszawa, 2006, 2007 (II wyd.).
2. Kwaśniewski J.: *Programmable Logic Controllers*. Roma-Pol, Kraków, 2002.
3. Parr E. A.: Programmable Controllers. An engineer's guide. (2nd edition) Newness, Manchester, 1999.
4. Stevenson J.: Fundamentals of Programmable Logic Controllers, Sensors and Communications, Prentice Hall, Englewood Cliffs, 1993.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30 / 10
2	Classes	0 / 0
3	Laboratory	30 / 10
4	Project	30 / 10
5	BA/ MA Seminar	0 / 0
6	Other	10 / 0
	Total number of hours	100 / 30

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

26. Comments:

Approved:

…… *(date, Instructor's signature)*

…… (*date , the Director of the Faculty Unit signature)*