



Subject card

Subject name and code	PROGRAMMABLE CONTROLLERS, PG_00053202						
Field of study	Automation, Robotics and Control Systems						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2022/2023		
Education level	first-cycle studies	Subject group			Obligatory subject group in the field of study Subject group related to scientific research in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	3	Language of instruction			Polish		
Semester of study	5	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Katedra Inteligentnych Systemów Sterowania i Wspomagania Decyzji -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Jarosław Tarnawski					
	Teachers	dr inż. Jarosław Tarnawski mgr inż. Tomasz Karla dr inż. Bartosz Puchalski dr inż. Tomasz Rutkowski					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours		Self-study		SUM
	Number of study hours	60	6.0		34.0		100
Subject objectives	PLC configuration and programming skills. Skills to implement advanced algorithms control in PLC. Ability to build a control system with SCADA and PLC with inputs / outputs and communication modules.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_W06	Students are able to perform software development for PLC and SCADA. Industrial hardware interfaces and communication are involved.			[SW1] Assessment of factual knowledge		
	K6_U05	Students are able to set up a hardware loop with the real-time simulated plant and PLC controller.			[SU1] Assessment of task fulfilment		
	K6_K02	Students working together solve control system synthesis problem with using the PLC and SCADA system.			[SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	<p>Location of programmable controllers (PLCs) in the control structure. Direct control issues and the requirements for real time devices. Historical outline of the PLC creation replacing the systems contactor-relay controls. Main features and requirements for PLC: reliability, flexibility, ease programming, scalability, communication possibilities. Standards IEC-1131 and EN61131. Functional elements of PLC. Division of PLC due to potential applications, construction, possibilities. Principle of operation of the PLC. PLC work cycle and real-time postulates. Determination functionalities of modular PLCs by: selection of the central unit, I / O modules, modules communication and specialized modules. PLC programming methods, languages: ladder, list instructions, sequential function diagrams, function block diagrams, structured text. Types available data, functions and data operations in PLC. Computational and programming limitations. Algorithms built-in methods of program implementation of simple control and regulation methods. Topics communication in PLC: data exchange between controllers, data exchange with other elements control structures. Selected communication standards in PLC - OPC, Modbus, Ethernet, Profibus. Implementation of decentralized and distributed control based on the PLC network. PLC cooperation with supervisory control systems and SCADA data acquisition systems. TUTORIALS Exercises with PLC text and graphical programming languages. Changing the form of the program between different languages. Data types, memory and CPU limits. Implementation of estimation, identification and control algorithms. LABORATORY Programming environment, configuration, basic blocks PLC software: rungs, contacts, relays. Timers and event counters, mathematical operations, relationships, data transfer and control blocks. Hardware connections to PLC - control looping measuring and executive devices. Programming the SCADA application and its cooperation with PLC. Standard communication OPC.</p>		
Prerequisites and co-requisites	Finished courses: Real-time systems, Informatics, Basics of Automation		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lab	50.0%	50.0%
	Oral exam	50.0%	50.0%
Recommended reading	Basic literature		<ol style="list-style-type: none"> Legierski T., Kasprzyk J., Wyrwał J., Hajda J. Programowanie sterowników PLC, Wydawnictwo pracowni komputerowej Jacka Skalmierskiego, 1998 Kacprzak S., Programowanie sterowników PLC zgodnie z normą IEC61131-3 w praktyce, Wydawnictwo BTC, 2011 Broel-Plater B., Układy wykorzystujące sterowniki PLC. Projektowanie algorytmów sterowania, PWN, 2009 Kwaśniewski J., Sterowniki PLC w praktyce inżynierskiej, Wydawnictwo BTC, 2008 Pietruszewicz K., Dworak P., Programowalne sterowniki automatyki PAC, Wydawnictwo Nakom, 2007
	Supplementary literature		<ol style="list-style-type: none"> Tatjewski P.: Sterowanie zaawansowane obiektów przemysłowych, Akademicka Oficyna Wydawnicza EXIT, 2002. Norma PN-EN 61131-3:2004 Sterowniki programowalne - część 3: Języki programowania, PKN, 2004. J. Korbicz, J.M. Kościelny Modelowanie, diagnostyka i sterowanie nadrzędne procesami Implementacja w systemie Diaster, WNT, 2009.
	eResources addresses		
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> The use of contacts and relays for the construction of switching systems Application of time relays and event counters Connecting PLC and SCADA to build a user interface Construction of hybrid programs: instruction list languages, ladder, structured text Application of built-in PID control algorithms Construction of an adaptive controller Implementation of the control system in the hardware loop structure 		
Work placement	Not applicable		