COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S2-ME-EM-213**
	part-time programme:	
Course title in Polish	**Sterowniki programowalne**	
Course title in English	**Programmable Logic Controllers**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**second-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**Machine Operation and Maintenance**
Department responsible	**Department of Mechatronics and Weapons Engineering**
Course leader	**dr hab. Jakub Takosoglu, prof. PŚk**
Approved by	**dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering**

COURSE OVERVIEW

Course type		**specialism-related**
Course status		**compulsory**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester II**
	part-time programme	**Semester II**
Pre-requisites		
Examination required (YES/NO)		**NO**
ECTS value		**2**

Mode of instruction		**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	full-time programme	**15**		**15**		
	part-time programme					

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	The student has structured advanced knowledge in the field of control, operation, and diagnostics of devices, manipulators, and complex industrial systems used in production automation.	MiBM2_W07
	W02	The student has structured, in-depth knowledge of control theory, PLC controllers, their programming, start-up, diagnostics, knows the methods of synthesis of control algorithms, has structured knowledge of the design, construction, control, and operation of industrial equipment.	MiBM2_W09
Skills	U01	The student is able to consciously use methods and tools to configure, connect, run, and program PLC controllers, is able to design and build control systems for industrial devices, is able to configure PLC controller inputs and outputs, and is able to measure, analyze, and scale electrical quantities using PLC controllers.	MiBM2_U08 MiBM2_U10
	U02	The student is able to work in a team, is able to organize and configure a laboratory station in accordance with guidelines, and is able to prepare a schedule for conducting laboratory tests.	MiBM2_U15
Competence	K01	The student is ready to critically evaluate his knowledge and the possibilities of acquiring new information in the field of designing control systems with PLC controllers in the field of mechanical engineering.	MiBM2_K01

COURSE CONTENT

Mode of instruction	Topics covered
lecture	Theoretical foundations of PLC controllers. Construction of PLC controllers. PLC programming. Standard. Methods of synthesizing control algorithms. Adaptation of a PLC controller to a control object. Data transmission to and from a PLC controller. Examples of automation of production processes using PLC.
laboratory	Getting to know the Telmatik PLC controller and laboratories using a simulator. Getting to know the S7-1200/1500 PLC controller, laboratories using a simulator. Getting to know the S7-300 PLC controller. Design, construction, programming,,, and start-up of basic device control systems: semi-automatic cycle, automatic cycle. Design, construction, programming and start-up of basic device control systems: START/STOP systems, safety systems. Design, construction, programming and start-up of basic device control systems: control according to cyclograms using previously learned systems. Design, construction, programming, and start-up of device control systems using analog signals. Automatic regulation of temperature or pressure using a PLC controller (PID controller). Auto-tuning of the PID controller. Production automation process using a PLC controller.

ASSESSMENT METHODS

Outcome code	Methods of assessment					
	Oral examination	Written examination	Test	Project	Report	Other

W01			X			
W02			X			
U01			X		X	X
U02			X		X	X
K01						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	**Assessment type**	**Assessment criteria**
lecture	non-examination assessment	Positive pass in the final test. At least 50% of points.
laboratory	non-examination assessment	Positive passing of tests and reports from the laboratories. The final grade is an arithmetic mean.

OVERALL STUDENT WORKLOAD

ECTS weighting												
No.	**Activity type**	**Student workload**										**Unit**
		full-time programme					**part-time programme**					
		L	C	Lb	P	S	L	C	Lb	P	S	
1.	Scheduled contact hours	**15**		**15**								h
2.	Other contact hours (office hours, examination)	**2**		**2**								h
3.	**Total number of contact hours**	**34**										h
4.	**Number of ECTS credits for contact hours**	**1,4**										ECTS
5.	**Number of independent study hours**	**16**										h
6.	**Number of ECTS credits for independent study hours**	**0,6**										ECTS
7.	**Number of practical hours**	**25**										h
8.	**Number of ECTS credits for practical hours**	**1,0**										ECTS
9.	**Total study time**	**50**										h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**2**										ECTS

READING LIST

1. Antonsen T., M.: Collection of Exercises for PLC Programming. Books on Demand, 2014.
2. Antonsen T., M.: PLC Controls with Ladder Diagram (LD): IEC 61131-3 and introduction to Ladder programming. Books on Demand, 2021.
3. Johnson Charles H. Jr.: PLC Programming from Novice to Professional: Learn PLC Programming with Training Videos. Lightning Source Inc, 2022.
4. Bolton W.: Programmable Logic Controllers. Elsevier Ltd. Oxford, 2015.
5. Szenajch W.: Napęd i sterowanie pneumatyczne. WNT, Warszawa 1992.
6. Mikulczyński T., Automatyzacja procesów produkcyjnych. WNT, Warszawa 2006.
7. Szelerski M.: Układy pneumatyczne w maszynach i urządzeniach. Wydawnictwo Kabe, 2018.
8. Dindorf R., Takosoglu J., Woś P.: Development of pneumatic control systems, Politechnika Świętokrzyska, Kielce 2017.

9. Dindorf R., Takosoglu J., Woś P.: Bezpieczeństwo układów hydraulicznych i pneumatycznych, Politechnika Świętokrzyska, Kielce 2018.
10. Dindorf R., Takosoglu J, Łaski P.: Poradnik konstruktora maszyn i urządzeń. (Zespół autorów pod redakcją A. Kubalskiego). Napędy i sterowanie pneumatyczne.
11. Dindorf R. pod red.: Hydraulika i Pneumatyka. Podręcznik Akademicki. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.
12. Dindorf R.: Napędy płynowe. Podstawy teoretyczne i metody obliczania napędów hydrostatycznych i pneumatycznych. Podręcznik akademicki. Wydawnictwo Politechniki Świętokrzyskiej, Kiel-ce, 2009.
13. Dindorf R. Elastyczne aktuatory pneumatyczne. Monografia. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2013.
14. Kowalowski H.: Automatyzacja dyskretnych procesów przemysłowych. WNT, Warszawa 1984.
15. Kowalski T., Lis G., Szenajch W.: Technologia i automatyzacja montażu maszyn. OW PW, Warszawa 2000.
16. Mikulczyński T., Samsonowicz Z.: Automatyzacja dyskretnych procesów produkcyjnych. WNT, Warszawa 1997.
17. Olszewski M.: Manipulatory i roboty przemysłowe. WNT, Warszawa, 1985.
18. Morecki A., Knapczyk J., Podstawy robotyki. Teoria i elementy manipulatorów. WNT, Warszawa 1999.
19. Pochopień B., Automatyzacja procesów przemysłowych. WSiP, Warszawa 1993.
20. Norma IEC 1131.
21. Kwaśniewski J.: Sterowniki PLC w praktyce inżynierskiej. Wydawnictwo BTC, Legionowo 2008.
22. Flaga S.: Programowanie sterowników PLC w języku drabinkowym. Wydawnictwo BTC, Legionowo, 2010.
23. Kwaśniewski J.: Sterowniki SIMATIC S7-1200 i S7-1500 w zaawansowanych systemach sterowania, Wydawnictwo BTC, Legionowo, 2018.