Subject programme

1. Subject name / subject module: **PLC programming**
2. Lecture language: **English**
3. The location of the subject in study plans:
   - Area or areas of the studies: **Computer Control Systems Engineering**
   - Degree of the studies: **2nd degree studies**
   - Field or fields (implementation of effects standard): **Mechatronics**
4. Supervision of subject implementation:
   - The Institute / Another unit: **The Institute of Informatics and Mechatronics**
   - The person responsible for the subject: **Ocetkiewicz Tomasz, mgr inż.**
   - People cooperating in the development of the programme of the subject:
5. The number of hours and forms of teaching for individual study system and the evaluation method

Form of classes Mode of study		SOW	ECTS	Laboratory work	SOW	ECTS	…	SOW	ECTS	…	SOW	ECTS	…	SOW	ECTS	…	SOW	ECTS	…	SOW	ECTS	Total ECTS
Full-time studies				47	53	4																4
Part-time studies																						
Credit rigor	…			Graded assigment																		

6. Student workload – ECTS credits balance

   1 ECTS credit corresponds to 25-30 hours of student work needed to achieve the expected learning outcomes including the student's own work

Activity (please specify relevant work for the subject)	Hourly student workload (full-time studies/part-time studies)
Participation in laboratory classes	**47**
Preparation to the laboratories	**21**
Independent study of the subject	**30**
Participation in an exam / graded assignment / final grading	**2**
Total student workload	**100**
ECTS credits	**4**
* Student's workload related to practical forms	**100**
Student's workload in classes requiring direct participation of academic teachers	**47**

7. Implementation notes: recommended duration (semesters), recommended admission requirements, relations between the forms of classes:

   None

   Recommended duration of the subject is taken from the course plan.
8. Specific learning outcomes – knowledge, skills and social competence

Specific learning outcomes for the subject		Form	Teaching method	Methods for testing of (checking, assessing) learning outcomes
Outcome symbol	Outcome description			
Knowledge				
K_W02	A student possesses sufficient knowledge of automation, electronics, and electrical engineering, necessary to understand control system structure and to apply this knowledge in practice through the use of appropriate methods, tools, and technologies to select programmable logic controller due to the control task and the plant.	Laboratory work	**Inquiry methods**	**Student learning activities**
K_W07	A student possesses sufficient knowledge in the field of technical informatics, necessary to understand PLC programming rules and to apply this knowledge in practice through the use of appropriate PLC programming			

			Skills	
	language and software environment due to the control task.			
			Skills	
K_U02	A student is able to use information and communication technologies (ICT) to create documentation of a PLC project/software and use the engineering graphics to prepare an effective HMI implementation.	Laboratory work	Inquiry methods	Student learning activities

9. Assessment rules / criteria for each form of education and individual grades

0% - 50%	ndst	**81% - 90%**	db
51% - 70%	dst	**91% - 93%**	db+
71% - 80%	dst+	**94% - 100%**	bdb

Activity	Grades	Calculation	To Final
Laboratory tasks	db; bdb; bdb; db (4; 5; 5; 4)	4 * 25% + 5 * 25% + 5 * 25% + 4 * 25% = 4.5	4.5

10. The learning contents with the form of the class activities on which they are carried out

(Laboratory work)

Technical guide for PLC basic system configuration of PLC-based process control; I/O refresh; cycle time; interrupt tasks; I/O allcation; CPU unit memory area; choosing a programming language for application. Ladder Diagrams(LD): instruction location and execution conditions; adressing I/O memory areas; data formats; refresh timing; condition flags; sequence input instructions; sequence output instructions; sequence control instructions; timer instructions; counter instructions; comparison instructions; data manipulation instructions; math and conversion instructions; logic instructions; subroutines instructions; interrupt control; high-speed pulse outputs; serial communication; network communication; clock instructions. Sequential Fuction Charts(SFC): elements of SFC; SFC program operation; SFC programming workflows; creating steps and transitions; creating action block; simulated transition tests; simulated operation tests; checking for program errors. Function Block/Structured Text: FB library; ST language; creation of a Function Block using ST; entering the FB to the Ladder Diagram. Using Matlab for PLC programming. Lab exercises: stepper motor control; DC motor control; electro-hydraulic control system; electro-pneumatic control systems; traffic lights simulator; HMI-PLC integration; ADAM-PLC integration.

11. Required teaching aids

Laboratory classes - specialist laboratory

12. Literature:
  a. Basic literature:

  1. D.H. Hanssen; Programmable Logic Controllers: A Practical Approach to IEC 61131-3 using CODESYS; ISBN 9781118949214; Wiley

  2. Automation Direct, PLC Handbook - cdn.automationdirect.com/static/eBooks/PLC%20Handbook.pdf
  a. Supplementary literature::

  1. Omron - Omron CP1L CPU Unit - Operation Manual

  2. Omron - Omron CP1H_CP1L CPU Unit - Programming Manual

  3. Omron - Technical Guide for PLC Basic

  4. Omron - CX-Programmer Introduction Guide R132-E1-04

  5. Omron Operation Manual SFC Programming
  b. Internet sources:

  1. Introduction to PLC Programming and Implementation - from Relay Logic to PLC Logic - www.industrialtext.com

  2. A Beginner's PLC Overview - www.automation.com/en-us/articles/2017/a-beginners-plc-overview-part-1-of-4-introduction

3. PLC Tutorial - www.javatpoint.com/plc

4. Omron FB/ST Introduction Guide - https://www.fa.omron.com.cn/data_pdf/mnu/r144-e1-04_cx-programmer.pdf?id=1605

5. Omron SFC Introduction Guide - https://assets.omron.eu/downloads/manual/en/r149_sfc_getting_started_guide_en.pdf

13. Available educational materials divided into forms of class activities (Author's compilation of didactic materials, e-learning materials, etc.)
14. Teachers implementing particular forms of education

Form of education	Name and surname
1. Laboratory classes	Ocetkiewicz Tomasz, mgr inż.