GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Introduction to AC&R, PG_00067265		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics Telecommunications and Informatics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	mgr inż. Marek Grzegorek	
	Teachers	mgr inż. Marek Grzegorek	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15
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	15	1.0	9.0	25

Subject objectives

The aim of the course is to introduce students to the fundamental principles of automation and robotics systems and their applications in industry and everyday life. The course covers key concepts related to control systems, control signals, regulators, and control methods such as PID, adaptive, and optimal control. Physical components of automation systems including sensors, actuators, PLC controllers, and drives are also discussed. Particular emphasis is placed on understanding system dynamics and their responses to stimuli, including the analysis of classic examples such as the inverted pendulum. The goal is to provide students with a solid foundation for further study in the fields of automation, robotics, and control systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W11] knows and understands, to an advanced extent, the general principles of setting up and development of business entities, forms of individual entrepreneurship and running ventures and the fundamental dilemmas of modern civilization and basic economic, legal and other conditions of various types of activities related to the field of study, including the basic concepts and principles in the field of industrial property and copyright protection	Understands the role of automation and robotics systems in the development of modern enterprises and their impact on social, economic, and technological transformations in contemporary civilization; knows examples of robot applications across various industries and the related legal and ethical aspects, including issues concerning the protection of industrial property.	[SW3] Assessment of knowledge contained in written work and projects
[K6_W10] knows and understands, to an advanced extent, the parameters, functions, and methods of analysis, design, and optimization of electronic circuits and systems, the definitions of error and measurement uncertainty, measurement methods, including time, frequency, and phase measurements, the properties of converters, and methods of digital signal processing, as well as the basic processes occurring in the life cycle of technical devices, objects, and systems, and methods of supporting processes and functions, specific to the field of study	Knows and understands the fundamental concepts and methods of analysis and design of automation systems, including the operation of controllers (PID, adaptive, optimal), the dynamics of control systems, the role of sensors, actuators, and PLC controllers in automation systems, as well as their applications in industry and robotics.	[SW3] Assessment of knowledge contained in written work and projects
[K6_W03] knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Knows the structure and operating principles of basic components of automation and robotics systems, such as sensors, actuators, PLC controllers, drives, and actuating mechanisms, and understands the interdependencies between these components and their impact on the operation of control systems.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

Lecture
Topics covered during the course (the list is not exhaustive):

Basic principles of operation of automatic systems and their significance in industry and everyday life

- Technological revolution in manufacturing, transport, and autonomous systems
- Applications of robots in various sectors, such as industry, medicine, and logistics
- Key concepts in automation: control systems, controllers, control signals, closed-loop systems
- Dynamics of control systems
- Basic control methods: PID control, adaptive control, optimal control
- Components of automation systems: sensors, actuators, PLC controllers, drives, and actuating elements their functions and applications
- System response characteristics (step and impulse responses)
- Analysis of the inverted pendulum as an example of an unstable system and the need to apply advanced control methods

Prerequisites and co-requisites

Basic knowledge of mathematics

Knowledge of basic physics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Report	60.0%	100.0%

Recommended reading

Basic literature	Mordechai Ben-Ari, Francesco Mondada, Elementy robotyki dla początkujących, Helion, Gliwice, 2022

	Supplementary literature	Stuart Russell, Peter Norvig, Sztuczna inteligencja: nowe spojrzenie. Tom 2, Helion, Gliwice, 2023
	eResources addresses	Basic https://manipulation.mit.edu/ - Robotic Manipulation https://underactuated.mit.edu/ - Underactuated Robotics
Example issues/ example questions/ tasks being completed	Characteristics of selected control methods used in robotics: position, velocity, torque, or current control Description and comparison of PID, adaptive, and optimal controllers in the context of industrial applications Analysis of the role of sensors and actuators in automation systems application examples and classification Description of a selected example of robot application in industry, medicine, or logistics, including assessment of technical and ethical aspects Description of the operation of a simple automation system (e.g., heating system, production line), including control elements Overview and classification of drive types used in automation and robotics Description of challenges related to maintaining stability in unstable systems (e.g., inverted pendulum) Extension of lecture topics with modern approaches to automation (e.g., machine learning in control, digital twins)	
Work placement	Not applicable	

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