GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automation and robotics, PG_00050283		
Field of study	Mechanical Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
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	English
Semester of study	5	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład Mechatroniki -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Michał Mazur	
	Teachers	dr inż. Michał Mazur dr inż. Wiktor Sieklicki	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	15.0	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	8.0	57.0	125

Subject objectives

Presentation of the fundamental issues related to automatic control systems, robots and manipulators. Knowing the structure and components of a typical control system. Gaining general information about the methods of designing, analysis and study of the properties of typical control systems. Acquisition of knowledge about the construction of typical, industrial robots and manipulators. Learning of methods for modeling, analysis and control of robots.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W06	The student knows the structure of a typical automation system and its components. He is able to build, design and analyze basic automatic control systems with the typical, universal industrial controllers.	[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge
[K6_U03] is able to identify, formulate and develop the documentation of a simple design or technological task, including the description of the results of this task in Polish or in a foreign language and to present the results using computer software or other aiding tools	He is able to build, design and analyze basic automatic control systems with the typical, universal industrial controllers.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents	Definition of basic terms. General structure of control system. Classification and examples of control system elements. Analog and digital control systems. Basic information about digital control systems. Boolean algebra. Combinational logic system. Sequential logic system. Design, synthesis and analysis of digital control systems. Basic information about analog control systems. A typical connections of components. Block diagrams and their transformations. Feedback. Description and classification of signals. Standard signals. Method of description control systems, elements and signals. Application of the Laplace transformation. Concept of transfer function. Static and dynamic characteristics of control systems. Time responses. Frequency characteristics. Nyquist and Bode plots. Controllers. Tuning of PID controller. Classification of robots and manipulators. Construction, modeling and analysis of robot motion. Introduction to robot control systems. The sensors used in industrial robots. Fundamentals of programming robots. Application of robots. Laboratory: Design of combinational and sequential logic circuits.Time and frequency characteristics of selected control system components. Programming of serial kinamatics, industrial robot Nachi MZ04 and parallel, delat type kinematics robot ABB IRB 360. Programming of collaborative robot Hanwha HCR3a.
Prerequisites and co-requisites	Mathematics, Physics, Mechanics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	56.0%	30.0%
Written exam	56.0%	40.0%
Laboratory (reports from laboratory exercises)	56.0%	30.0%

Recommended reading

Basic literature	Craig J., J., Introduction to Robotics: Mechanics and Control Vidyasagar M., Spong Mark W.: Robot Modeling and Control Siciliano B., Khatib O.: Springer Handbook of Robotics. Berlin: Springer 2008
Supplementary literature	Kaltenbacher, Manfred. *Numerical simulation of mechatronic sensors and actuators*. Vol. 2. Berlin: Springer, 2007 Hatzfeld, Christian, and Thorsten A. Kern. *Engineering haptic devices*. Springer London Limited, 2016
eResources addresses	Adresy na platformie eNauczanie: Automation and robotics, Lab, MiBM, st. I, sem.5 (PG_00050283) 10.2023 - Moodle ID: 27480 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=27480 Automation and robotics, Lab, MiBM, st. I, sem.5 (PG_00050283) 10.2023 - Moodle ID: 27480 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=27480

Example issues/ example questions/ tasks being completed	Automation 1. Describe the ACS scheme - Give an example 2. Spectral transmittance 3. What is the static characteristic of the term? 4. Approximation of the nonlinear static characteristic of the term in the vicinity of the operating point 5. The proportional term 6. 1st order inertial term 7. The integral term 8. The oscillating term 9. The ideal derivative term 10. Real derivative term 11. The delay term 12. Phase shift term 13. Stability of automation systems 14. Hurwitz criterion 15. Nyquist criterion 16. Static error 17. PID controller 18. Two-position regulation 19. Controllability 20. Observability 21. Optimum control with total quality criterion Robotics 1. What is an industrial robot? 2. What is a mobile robot? 3. What is a manipulator? 4. What does robotics do? 5. Applications of industrial robots. 6. Introduce and describe the basic kinematic structures of stationary industrial robots. 7. What is the difference between a robot with a kinematic structure in the Cartesian system and a robot with a kinematic structure in an anthropomorphic system? 8. List and discuss the basic units and systems of an industrial robot. 9. Advantages and disadvantages of robots with a parallel structure. 10. List the applications of mobile robots. 11. What is a workspace? 12. What is a manipulation space? 13. What is the task of simple kinematics? 14. What is the inverse of kinematics? 15. Tasks of the control system. 16. Describe methods of programming industrial robots. 17. What are servo drives? 18. What is positioning accuracy? 19. What is repeatability? 20. Applications and types of interpolation in robotics. 21. List the advantages and disadvantages of the hydraulic drive for industrial robots. 22. List the advantages and disadvantages of a pneumatic drive for industrial robots. 23. List the advantages and disadvantages of an electric drive for industrial robots. 24. Requirements for gears used in industrial robots. 25. Discuss the applications and operation of helical gears. 26. Discuss the application and operation of harmonic gear. 27. Discuss the operation of revolvers. 28. Discuss the operation of encoders. 29. Describe the operation of ultrasonic proximity sensors. 30. Applications of touch sensory systems.
Work placement	Not applicable