GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Manipulators and industrial robots, PG_00055470		
Field of study	Mechatronics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
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	6	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Michał Mazur	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	0.0	45

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	45	2.0	28.0	75

Subject objectives

The aim of the course is to acquaint students with the construction, basic elements, programming and operating principle of industrial robots and manipulators.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U02] is able to elaborate on specific mechatronic topics as well as topics from engineering and technology sciences and disciplines such as Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies	can use the card catalog in order to select the appropriate components of the proposed position of the robot	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_W10] has knowledge about development trends in the field of engineering and technology sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies, adequate for Mechatronics curse	has a basic knowledge on developments in the field of Robotics.	[SW3] Assessment of knowledge contained in written work and projects
[K6_U10] is able - while formulating and solving mechatronic engineering tasks - to notice their systemwide and non-technical aspects	can - in formulating and solving engineering tasks robotics - recognize their systemic and nontechnical aspects	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information

<table>
<tr><td>Subject contents</td><td>Course content – lecture
LECTURES Introduction to robotics, the basic concepts and definitions; Classification of robots and manipulators. Basic systems and units of robots - the control system, the mechanism of motion transmission. The parameters describing the manipulators and robots - the accuracy and repeatability of movements. Effectors of industrial robots; Classification of grippers, Motion transmission and equipment of grippers. Kinematics of robots and manipulators; Rotations and assembling of rotations, Homogeneous transformations, Denavit-Hartenberg notation. Simple and inverse kinematics. The dynamics of robots; Lagrange equations, Newton-Euler equations. Simple and inverse dynamics. Geometric and functional characteristics and manipulators motion planning. Analysis of the manipulator workspace. Sensors used in industrial robotics. Fundamentals of manipulators and robots control. Examples of control systems. The basics of robots programming; Programming languages. Methods of shapes and objects identifying; Tracking of moving objects and determination of movement parameters. Control of mobile robots. Examples of applications of industrial robots and manipulators.

LABORATORY EXERCISES The construction and programming of industrial stationary robots. Programming of trajectory of industrial robot IRb 2400 effector. Cooperation of the industrial robot IRb 2400 with apron feeder. The methods of measurement and analysis of functional characteristics of industrial robots. The construction and programming of mobile robots.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of mathematics, physics, mechanics, strength of materials, base machine design.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Written examination</td><td>50.0%</td><td>60.0%</td></tr><tr><td>Laboratory Exercises</td><td>100.0%</td><td>40.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>Craig J., Wprowadzenie do robotyki. Mechanika i sterowanie, WNT, Warszawa, 1993. Honczarenko J., Roboty przemysłowe. Budowa i zastosowanie, WNT, Warszawa, 2002. Jarzębowska E., Podstawy dynamiki mechanizmów i manipulatorów, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 1998. Morecki A., Knapczyk J., Podstawy robotyki. Teoria i elementy manipulatorów i robotów, WNT, Warszawa, 1993. Morecki A., Knapczyk J., Kędzior K., Teoria mechanizmów i manipulatorów,WNT, Warszawa, 2002.</td></tr><tr><td>Supplementary literature</td><td>Dulęba I., Metody i algorytmy planowania ruchu robotów mobilnych i manipulacyjnych, Akademicka Oficyna Wydawnicza EXIT, Warszawa, 2001.</td></tr><tr><td>eResources addresses</td><td></td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>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 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.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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