GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Robotics, PG_00057380
Field of study	Mechanical Engineering, Space and Satellite Technologies

Date of commencement of studies	February 2024	**Academic year of realisation of subject**	2023/2024
Education level	second-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**	English
Semester of study	1	**ECTS credits**	2.0
Learning profile	general academic profile	**Assessment form**	assessment

Conducting unit	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	15.0	0.0	15.0	0.0	0.0	30
	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	30	4.0	16.0	50

Subject objectives	Expanding knowledge about robots and manipulators. Some specific issues relating to the actors, sensors and control systems.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W06] possesses organized, profound knowledge necessary for designing and optimization of complex technological processes, modelling and calculations using numerical methods, knows modern manufacturing methods and tools for designing manufacturing processes of machines, devices, their elements and components	Students have theoretically founded knowledge related to the field of robots.	[SW3] Assessment of knowledge contained in written work and projects
	[K7_W05] possesses profound knowledge on the operation of complex systems and mechanical devices, including process equipment	Students know how robots work.	[SW3] Assessment of knowledge contained in written work and projects
	[K7_U05] is able to plan and conduct the experimental research determining the parameters of a device or system, assesses the usability and correctly selects methods and tools, is able to interpret the results and estimate the measurement errors and is able to apply computer systems to simulate the operation of a machine or technology	Students analyze the knowledge contained in scientific publications in order to solve the problems posed to them.	[SU2] Assessment of ability to analyse information

Subject contents	LECTURE: 1 Introduction 2 Modern trends in the development of two industrial robots 3 Sensors 4 Signal Conditioning 5 Tactile and haptic sensors 6 Methods of localization of mobile robots 7 Effectors 8 Elements of power supply systems 9 Drive chain elements used in robots 10 Tools for robot programming and simulation
	Laboratory: 1 Programming delta type robot task for ABB IRB360 robot 2 Programming collaborative robot tasks for HCR3a robot using OnRobot vision system 3 Programming of industrial robot movements with force sensor feedback for Nachi NC04 robot 4. developing control algorithms for modular systems using LEGO Mindstroms sets 5. kinematics and dynamics of manipulator movements using the RobotAnalyzer program 6. Development of the manipulator's movement path for the purpose of implementing a specific movement task in a simulation using the Nachi MZ04 manipulator available in the RoboDK 7 program libraries. Operating the Nachi NC04 robot and programming its movement trajectory using a robot controller 8. Operating the IRB360 robot and preparing the manipulator's movement path for the purpose of implementing a specific robot movement task using the RobotStudio program and a robot controller.
Prerequisites and co-requisites	Basics of mathematics, mechanics and automation, the ability to program engineering calculations.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory report	50.0%	40.0%
Midterm colloquium	50.0%	60.0%

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 • R.C. Dorf, R.H.Bishop, Modern Control Systems, Prentice Hall, 2008 • N.S. Nise, Control Systems Engineering, Wiley, 2015 • G.F. Franklin, J.D. Powell, A. Emami-Naeini, Feedback Control of Dynamic Systems, Addison-Wesley, 1994 • K. Astrom, R. Murray [AM]. Feedback Systems. An Introduction for Scientists and Engineers, Princeton University Press, 2012 • K. Ogata [O]. Modern Control Engineering, Pearson, 5th Edition, 2010
Supplementary literature	• Borenstein J., Everett H. R., Feng L.: Where am I? Sensors and Methods for Mobile Robot Positioning. Publikacja elektroniczna. University of Michigan 1996. http://www-personal.umich.edu/~johannb/Papers/pos96rep.pdf
eResources addresses	Adresy na platformie eNauczanie: Robotics, WL, IDE, sem.01, letni 2023/24 (PG_00057380) - Moodle ID: 38061 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=38061

Example issues/ example questions/ tasks being completed	What is a sensor? Advantages and disadvantages of digital sensors? Advantages and disadvantages of analog sensors? Discuss conditioning. Haptic systems.Robots development trends. Advantages and disadvantages of ultrasonic sensors for distance measurement. List the location methods. Techniques for measuring distance. Advantages and disadvantages of monolithic architecture. Advantages and disadvantages of distributed architecture. Robust programming - fault detection techniques. Application of real-time systems in robot control. What is SLAM? What do we use quaternions for? Discuss Spherical Linear Interpolation Applications of dual quaternions. What is ROS? Discuss MoveIT Discuss 2D Navigation in a ROS environment Discuss the control of the qaudrocopeter What is Zero Moment Point?
Work placement	Not applicable