GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	ROBOT PROGRAMMING AND TASK PLANNING, PG_00053203		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	Optional subject group 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	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Katedra Biomechatroniki -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mariusz Dąbkowski	
	Teachers	dr inż. Mariusz Dąbkowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	20.0	0.0	0.0	50

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	50	7.0	23.0	80

Subject objectives

The aim of the course is to familiarize students with theoretical issues related to the description of direct kinematics (Denavit-Hartenberg approach) and inverse kinematics of serial manipulators, tasks and construction of industrial robot control systems, and practical issues regarding robot programming in the MB4 and Movemaster languages.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U05	The student is able to use advanced functions of the Cosimir environment for creating and visualizing robotic production stations in 3D. The student is able to formulate and program given complex motion trajectories of industrial robots. The student uses basic and advanced instructions to control the movement of Mitsubishi Melfa-RV-2AJ robots in the MelfaBasic IV and Movemaster languages.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
K6_W10	The student defines the task of direct and inverse kinematics of stationary robots. In practice, he uses the Denavit-Hartenberg description to solve the problem of simple kinematics. Lists and characterizes the tasks of control systems for stationary robots. Characterizes robot learning methods - CPC and PTP.	[SW1] Assessment of factual knowledge
K6_K02	The student carries out the assumed practical tasks of programming industrial robots in a group of several people using computer technology.	[SK1] Assessment of group work skills [SK4] Assessment of communication skills, including language correctness [SK3] Assessment of ability to organize work

Subject contents	Lecture: Robot kinematics: coordinate systems, coordinate transformations, manipulator structures, Denavit-Hartenberg description, direct and inverse kinematics, statics of manipulators. Introduction to robot control and programming. Tasks of control systems: response to signals from measurement systems of motion parameters - two-state drives, control of motion units positioned within the entire range of displacements, control and coordination of subsystems of the robot workstation components, determining the sequence of operations - linear and branched programs. Point (PTP) and continuous (CP) control systems. Classification of control systems - teleoperator control, sequential control (relay systems, with PLC controllers), numerical control systems with hardware and computer structure. Circuits programmed by teaching. Review of navigation methods for industrial mobile robots. Layers of industrial robot control systems - drive control layer, drive coordination layer, trajectory programming layer - robot learning task, movement trajectory determination layer. Modern Mitsubishi robots manipulator structure, hardware structure of the control system, applications. Program structure in Mitsubishi robot programming languages: Melfa Basic IV and Movemaster. Basic functions of the Melfa Basic IV and Movemaster languages - instructions controlling the position and movement of the manipulator arm, program control instructions, instructions controlling the working head. Structure and operation of the COSIROP environment for controlling Mitsubishi Melfa robots. Structure and operation of the COSIMIR environment for creating and simulating the operation of robotic production stations. Basic package functions. Methodology of introducing robots into industry. Safety at robotic production stations. Characteristics of industrial robots. Laboratory: The laboratory includes a set of exercises related to programming stationary robots.
Prerequisites and co-requisites	Basic knowledge of COSIROP and COSIMIR programs. Knowledge of basic commands in MELFA BASIC 4.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Raports	50.0%	50.0%
Exam	50.0%	50.0%

Recommended reading

Basic literature	1. Spong M. W., Vidyasagar M.: Dynamika i sterowanie robotów. WNT. Warszawa, 1997. 2. Kozłowski K., Dutkiewicz P., Wróblewski W.: Modelowanie i sterowanie robotów, PWN, Warszawa: 2003. 3. Tchoń K., Mazur A., Dulęba I., Hossa R., Muszyński R.: Manipulatory i roboty mobilne, Akademicka Oficyna Wydawnicza PLJ, Warszawa: 2000. 4. Instruction manual. CR1/CR2/CR3/CR4/CR7/CR8/CR9 Controller. Detailed explanations of functions and operations. Mitsubishi Industrial Robot. Melfa BFP-A5992-M. 2007. 5. Instruction manual. CR1/CR2 Controller. Explanations of Movemaster commands. Mitsubishi Industrial Robot. Melfa BFP-A8056-D. 2005
Supplementary literature	1. Instruction manual. CR1/ CR1B Controller. Controller setup, basic operation and maintenance. Mitsubishi Industrial Robot. Melfa BFP-A8054-H. 2005. 2. Instruction manual. RV-1A/2AJ Series. Robot arm setup and maintenance. Melfa BFP-A8052-D. 2002.
eResources addresses	Adresy na platformie eNauczanie: PROGRAMOWANIE ROBOTÓW I PLANOWANIE ZADAŃ [2023/24] - Moodle ID: 32132 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32132

Example issues/ example questions/ tasks being completed	1. A simple kinematics problem of serial stationary robots with three degrees of freedom. 2. Inverse kinematics problem of serial stationary robots with three degrees of freedom. 3. Layers of industrial robot control systems. 4. Control methods for stationary robots (PTPC and CPC). 5. Tasks of industrial robot control systems. 6. Methods for interpolating the movement trajectories of industrial stationary robots. 7. Basic motion control instructions in Melfa Basic IV and Movemaster.
Work placement	Not applicable