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 2020	Academic year of realisation of subject	2022/2023
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 simple kinematics (Denavit-Hartenberg approach) and inverse kinematics of serial manipulators, tasks and construction of industrial robot control systems, and practical issues concerning programming robots in MB4 and Movemaster languages.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W10	Student defines the task of simple and inverse kinematics of stationary robots. He applies the description of Denavit-Hartenberg in practice to solve the problem of simple kinematics. Lists and characterizes the tasks of stationary robot control systems. Characterizes the methods of teaching robots - CPC and PTPC.	[SW1] Assessment of factual knowledge
K6_K02	Student carries out the assumed practical tasks of programming industrial robots in a group of several people using the means of computer technology.	[SK3] Assessment of ability to organize work [SK4] Assessment of communication skills, including language correctness [SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills [SK2] Assessment of progress of work
K6_U05	Student is able to formulate and program the given complex trajectories of the movement of industrial robots. Student is able to use the advanced functions of the Cosimir environment for creating and visualizing robotic production stations in 3D. Student uses the basic and advanced instructions for controlling the motion of Mitsubishi Melfa-RV-2AJ robots in MelfaBasic IV and Movemaster languages.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

Subject contents	Lecture: Robot kinematics: coordinate systems, coordinate transformations, manipulator structures, Denavit-Hartenberg's description, simple and inverse kinematics, statics of manipulators. Introduction to robot control and programming. Tasks of control systems: reaction to signals of measurement systems of motion parameters, two-state drives, control of motion units positioned in the entire range of displacements, control and coordination of component subsystems of the robot's workstation, determining the sequence of operation, linear and branched programs. Point (PTP) and continuous (CP) control systems. Classification of control systems, teleoperator control, sequence control (relay systems, with PLC drivers), numerical control systems with a hardware and computer structure. Circuits programmed by teaching. Overview of the navigation methods of industrial mobile robots. Layers of industrial robot control systems, drives control layer, drives coordination layer, trajectory programming layer, robots learning task, motion trajectory determination layer. Modern Mitsubishi robots - construction of a manipulator, 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 language, instructions controlling the position and movement of the manipulator arm, program control instructions, operating head control instructions. Structure and operation of the COSIROP environment for controlling Mitsubishi Melfa robots. The structure and operation of the COSIMIR environment for creating and simulating the work of robotic production stations. Basic features of the package. 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 the basic commands in MELFA BASIC 4.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Reports	100.0%	50.0%
Written exam	50.0%	50.0%

Recommended reading

Basic literature	1. Spong. M. W., Vidyasagar M.: Dynamika i sterowanie robotów. Wydawnictwo Naukowo-Techniczne. 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	

Example issues/ example questions/ tasks being completed	Simple problem of kinematics of serial stationary robots with three degrees of freedom. The inverse of the kinematics of serial stationary robots with three degrees of freedom. Layers of industrial robot control systems. Methods of controlling stationary robots (PTPC and CPC). Tasks of industrial robot control systems. Methods of interpolation of the trajectory of motion of industrial stationary robots. Basic motion control instructions in Melfa Basic IV and Movemaster.
Work placement	Not applicable