

Course description

1 General information

Course name	Fundamentals of Robotics
Course code	M6-FR
Level of study (B.Sc, M.Sc., Ph.D.)	B.Sc
ECTS	4
Course manager	Ph.D. Eng. Stanislaw Krenich, Production Engineering Institute
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- Basic knowledge on math analysis, mechanics and electrical engineering.

2 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	15		15		15	

3 Contents

Lectures		
No.		Hours
1	Classification of robots. Elements of mechanical, drive and sensory systems, CNC and PLC control system. Examples of robots and their use.	4
2	Calculations of a robot position and orientation in the workplace. Forward kinematics.	3
3	Determination of dependencies on linear and angular velocity of robot members, Jacobi matrix.	2
4	Inverse kinematics task, generating a trajectory of the robot's movement or its effector.	2
5	Methods and languages of robot programming.	2
6	Short introduction to dynamics of robots.	2

Labs		
No.		Hours
1	Calculation of coordinates of the position and orientation of the robot effector, online validation.	4
2	Experimental determination of Jacobi matrix elements, differential kinematics.	3
3	Research on positioning repeatability and static stiffness using contact methods or vision systems.	2
4	Experimental validation on force relationships of the robot arm or robot gripper under static equilibrium.	2
5	Simple programming of robots by block teaching or using programming language.	4

Project		
No.		Hours
1	Determination of kinematic relationships for a design of an industrial manipulator, recursive methods.	5
2	Project of a robot gripper for a given object.	5
3	Programming and simulation of industrial robots in multi-device production systems using virtual applications (K-Roset, RoboGuide, etc.)	5

3 Learning Outcomes (skills and knowledge):

- The student knows mechanical parts, sensors and working rules of industrial robots.
- The student is able to use D-H notation for the description of robot kinematics.
- The student has knowledge about basic principles of discrete and CNC control systems of robots.
- The student can measure and study functional parameters of robots.
- The student has basic programming and operation skills for industrial robots.

4 Assessment policy (examination):

- Homework and active participation in the classes.
- Written reports and tests for lab exercises.
- Team projects.
- The final grade is an average from labs and projects.

5 Literature

1. Craig J. J — Introduction to Robotics: Mechanics and Control, MA, 1989, Addison-Wesley PC.
2. Spong M. W., Hutchinson S., Vidyasagar M— Robot modeling and control, NY, 2006, John Wiley& Sons.
3. Angeles J — Fundamentals of Robotic Mechanical Systems. Theory, Methods, and Algorithms, NY, 2007, Springer.
4. Manuals for industrial robots Kawasaki RS10L, Fanuc ArcMate 100i, Fanuc S420F.
5. Manuals for K-Roset, Robo-Guide applications.