Code	IV.3.
Course Title (English)	**Automatic Control and Robots**
Course Title (Polish)	**Automatyka i robotyka w procesach produkcyjnych**
Credits	3 ECTS

Language of instruction **English**

Compulsory for Profile: Computer Modelling and Simulation (CMS), Intelligent Energy (IE), Biotechnology for Environmental Protection (BI), Business and Technology (BT)*

Type of studies BSc studies

Unit running the programme Institute of Mechanical Technologies

***Course coordinator** and academic teachers* **Tadeusz Nieszporek, Assoc. Prof.,** Tadeusz Nieszporek, Assoc. Prof., (lec.), Andrzej Piotrowski, PhD eng., (lec.).

Form of classes and number of hours

Semester	Lec.	Tut.	Lab.	Proj.	Sem.	Credit points
IV	30		15			3

Learning outcomes In lectures students learn the design, construction and programming of control systems for automating production processes, machinery and equipment. They learn about the construction and operation of robots and manipulators. The task simple and inverse kinematics allows to determine the area of operation and functions of the robot internal variables, including velocity and acceleration, depending on the trajectory of the gripper. Lagrange'a method or Newton-Euler equations can be determined forces and moments acting on the nodes, which allows for the selection of propulsion systems and robotic manipulators. Students learn the elements (systems implementation, drive systems and sensors), pneumatics, hydraulics and electronics, which are used to automate machines, equipment and manufacturing processes. Most control is achieved by programmable PLC and HMI touch screen operator panels.

Prerequisites Basic knowledge of physics and mathematics

Course description LECTURE

Introduction to Robotics. Brief history of robotics.
Automatic control systems.
The nature and classification of automatic control systems. Logic. Linear circuits.
Nonlinear systems. Basics of computer control systems.
Fundamentals of control.
Binary control. PLC and HMI. PID. Servo. Methods for modeling discrete and PLC programming.

Components, equipment and automation systems.
Measuring devices. Actuators. Regulators. Servomechanisms.
Digital devices in automation systems.
The types of signals.
Input and output devices in computer control systems.
Robots and manipulators.
The structure of manipulators and robots. Denavit Hartenberg homogeneous coordinates.
Simple task kinematics. Inverse task kinematics.
Dynamics of manipulators - Newton-Euler algorithm, the algorithm Lagrange'a.
Construction and control of manipulators and robots.
Grippers of manipulators and robots.
Drives and mechanisms used in robots. Sensors.
Gripper trajectory planning.
Control and programming of manipulators and robots.
Examples of applications of manipulators and robots.

TUTORIALS: see lecture content

LABORATORY

PROJECT
not applicable

SEMINAR
not applicable

Form of assessment Exam

Basic reference materials

1. Craig J.J.: Introduction to robotics. Addison-Wesley 1989
2. Siciliano Bruno, Khatib Oussama: Handbook of Robotics. Springer 2008
3. Reza N. Nazar: Theory of Applied Robotics: Kinematics, Dynamics and Control. Springer 2007
4. Joe Jones, Daniel Roth: Robot Programming: A Practical Guide to Behaviour-Based Robotics. McGraw-Hill 2004
5. J. Norberto Pires: Industrial Robots Programming: Building Applications for the Factories of the Future. Springer 2007
6. Shimon Y. Nof: Handbook of Industrial Robotics. John Wiley & Sons 1999
7. Kyle Johns, Trevor Taylor: Professional Microsoft Robotics Developer Studio. Wrox, Wiley Publishing Inc. 2008
8. Thomas R. Kurfess: Robotics and Automation Handbook. CRC Press 2005
9. Hough Jack: Automating Manufacturing Systems with PLCs. Hugh Jack 2004

Other reference materials

For Polish-speaking students:

1. Świder J., Baier A., Kost G., Zdanowicz R.: Sterowanie i automatyzacja procesów technologicznych i układów mechatronicznych. Układy pneumatyczne i elektro-pneumatyczne ze sterowaniem logicznym (PLC). Wydawnictwo Politechniki Śląskiej, Gliwice 2006
2. Urbaniak A.: Podstawy automatyki. Wydawnictwo Politechniki Poznańskiej, Poznań 2001
3. Kostro J.: Elementy, urządzenia i układy automatyki. WSiP, Warszawa 2006
4. Mikulczyński T.: Automatyzacja procesów produkcyjnych. WNT, Warszawa 2006
5. Pr. Zb. Pod red. Hejmo W.: Sterowanie robotami I manipulatorami przemysłowymi. Modele i metody matematyczne. Politechnika Krakowska, Kraków 1997
6. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów. Podstawy i przykłady zastosowań w praktyce. WNT, Warszawa 2002
7. Pr. zb. pod red. Moreckiego A. i Knapczyka J.: Podstawy robotyki. Teoria i elementy manipulatorów i robotów. WNT, Warszawa 1999

8. Jezierski J.: Dynamika robotów. WNT, Warszawa 2006
9. Honczarenko J.: Roboty przemysłowe: budowa i zastosowanie. WNT, Warszawa 2004
10. Craig J.J.: Wprowadzenie do robotyki. Mechanika i sterowanie. WNT, Warszawa 1993

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Average student workload (teaching hours + individ.)	3 hours of teaching hours + 2 hours of individual work per week
Remarks:	
Updated on: 02.02.2015	