Subject description

Faculty of Architecture, WUT 2020, **Architecture** studies

Architecture for Society of Knowledge speciality

ROBOTICS		**ASK3-KT-Rb**	**MSc level**	**semester 3**
Classes: **lecture** **laboratory**	Hours/semester **15** **15**	Student's workload hours: **18**	Status: **obligatory** Level: Basic Context: technology	ECTS: **2** Exam: **no**

Unit delivering this subject: Institute of Automatic Control and Robotics
Subject coordinator: dr inż. Krzysztof Kukiełka
Room: 340 (Faculty of Mechatronics **Secretary:** 253 (Faculty of Mechatronics)
Teacher: dr inż. Krzysztof Kukiełka, dr inż. Piotr Wasiewcz, mgr inż. Arkadiusz Winnicki

Learning outcomes and subject delivery methods

Objective of the course:

After completing the course, students gain knowledge in the field of actuators used in automation and robotics. Also become familiar with programmable control systems and industrial robots. They can build pneumatic circuits performing simple tasks using essential pneumatic components. They will also learn the programming language used for PLCs and industrial robots. They can prepare a program or for the controller robot executing a specific task.

General description of the course:
Subject introduces students to issues related to automation and robotics. Acquaints with the primary actuators used in automation and robotics, and shows the basic systems controlling these elements. These systems are popularly called programmable logic controllers (PLC). Getting to know the structure of controllers, the principles of their operation and programming languages, allows for the construction of control systems (including the preparation of logic) of simple automation and robotics systems. An example of advanced automation and robotics equipment are industrial robots. The combination of a dedicated control system with a manipulator powered by electric motors, allows the robots to perform complex manipulative activities that make up the industrial process. Laboratory classes complement the theoretical knowledge conveyed during the lecture. During the laboratory classes, it is possible to get physical acquainted with discussed devices.

Learning outcomes:

No. of the outcome/ area	**Description**
Knowledge	
W_01	Student presents knowledge about construction and operation of pneumatic, hydraulic and electrical system using to machines and robots construction
W_02	Student presents knowledge in the structure and the practical possibility of programmable logic controllers.
W_03	Student presents knowledge in the scope of construction, possibilities and the programming of industrial robots.
Skills	
U_01	Student understand the principle of operation the pneumatic, hydraulic and electrical systems

U_02	Student can develop a program for the PLC realising simple logic task.
U_03	Student can independently prepare a program for industrial robot realising a simple robot trajectory.
Social competences	
KS_01	Student works in a group, fulfilling different roles.
KS_02	Student acts creatively.

Learning contents:

Lecture:

Actuators:

Introduction to robotics. Types of Robots. The structure of pneumatic systems. Control valves. Linear cylinders. Rotary cylinders. Speed regulation. The structure of hydraulic systems. Advantages and disadvantages of hydraulics. Types of electrical motors. Comparison of synchronous and asynchronous motors. Stepper motors.

Programmable logic controllers:

Tasks and areas of application of PLC. The construction and classification of PLC. IEC 61131. The principle of a PLC. PLC programming languages according to IEC 61131-3. PLC algorithms. Examples of design logic circuits using the Siemens LOGO Soft Comfort and Festo FluidSIM software.

Industrial robots

Classification of industrial robots. The construction of the robot. Parameters of the robot. Typical robotic applications. Introduction to robots programming. Examples of programming language instructions of Fanuc industrial robots.

Laboratory classes:

Exercise # 1: Operating pneumatics systems

The use of pneumatic components available for the construction of pneumatic systems listed in the form of diagrams. Understanding the principles of simple pneumatic circuits.

Exercise # 2: Operating and basic programming of industrial robots

Getting acquainted with the construction and operation of industrial robots which are in the laboratory. Preparation of programs performing simple robot movement trajectories.

Exercise # 3: Basics of PLC controller programming

Preparation simple logic functions. PLC programming using different programming languages.

Teaching methods and forms :

Compulsory lectures, discussions during lecture.
Laboratory exercises. Realisation group tasks in the classroom.

Method of testing the learning outcomes:

Outcome Number	Way of testing
Knowledge	
W_01	Lectures - qualifying test, the laboratory - the implementation of exercise 1.
W_02	Lectures - qualifying test, the laboratory - the implementation of exercise 2.
W_03	Lectures - qualifying test, the laboratory - the implementation of exercise 3.
Skills	
U_01	Laboratory - the realisation of the tasks assigned to the exercise No. 1.
U_02	Laboratory - the realisation of the tasks assigned to the exercise No. 2.
U_03	Laboratory - the realisation of the tasks assigned to the exercise No. 3.
Social competences	
KS_01	Laboratory – group work, assessment based on the tutor's observation during the classes.
KS_02	Laboratory - evaluation of the correctness and the way of solving an entrusted problem

Literature

Basic:

- Newton C. Braga: "Robotics, Mechatronics, and Artificial Intelligence"
- Morecki A. i in.: Podstawy robotyki. WNT, Warszawa 2002 (II wydanie).

- Honczarenko i in.: Roboty przemysłowe. Budowa i zastosowanie. WNT, Warszawa 2004.
- Olszewski M. i in.: Mechatronika. REA, Warszawa 2002.

Complimentary:

- Clarence W. de Silva: "Mechatronics: A Foundation Course"
- Andrew Parr: "Hydraulics and Pneumatics, Third Edition: A technician's and engineer's guide"
- Olszewski i in.: Podstawy mechatroniki. REA, Warszawa 2006.
- Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. PWN, Warszawa 2001.
- Craig J.J.: Wprowadzenie do robotyki. Mechanika i sterowanie. WNT, Warszawa 1995.