COURSE DESCRIPTION CARD - SYLLABUS

Course name
Industrial robot programming [N2AiR1-ISAiR>PRP]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
Intelligent Control and Robotic Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
10

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student starting the subject should have a basic knowledge of automatic control and robotics. One should also be able to obtain information from specified sources and be willing to cooperate as part of a team.

Course objective

The aim of the course is to familiarize students with the fundamentals of robot programming. Theoretical foundations are illustrated with examples and practical exercises using the robots Kuka KR200. The aim of the course is also to familiarize students with the basics of off-line robot programming using the ABB RobotStudio simulation software.

Course-related learning outcomes

Knowledge
1. The graduate has an well-structured knowledge of classification, construction and kinematic structures, mathematical description, principles of operation and programming of manipulation robots.
2. The graduate knows and understands to an advanced level the theory and methods in the field of design, application and control of actuators of automatics and robotics.

3. The graduate knows and understands the basic processes occurring in the life cycle of devices and selected security systems used in automation and robotics.
Skills
1. The graduate has basic exploitation and operator skills of industrial robos.
2. The graduate is able to create, test and run a simple motion program for an industrial manipulator; is able to solve basic tasks related to robot kinematics.
3. Can plan, prepare and simulate the operation of simple robotics system using off-line programming software.
Social competences
1. The graduate is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture: written exam (checking theoretical knowledge) in the basics of industrial robots programming.
Laboratory: checking practical skills in programming of Kuka robots, as well as performing off-line robot programming tasks using the RobotStudio system, evaluation of tests and report

Programme content

Lecture. Acquainting with the rules of safety at the workplace with an industrial robot. Discussion of the basics of robot programmingincluding: hardware and software of the robot controller including VxWorks real-time operating system, principles of manual control and program startup, tool calibration in various ways, controller operation modes, kinematic singularities and their consequences in manipulator motion, standard motions and their parameters, exact and approximate positioning, motion planning in the joint and cartesian space. Principles of proper planning of robot tasks. Issues of interaction with external devices through exchange of input / output signals. Work of robots dividing the work space, the principle of locking the areas. Presentation of sample production programs. Presentation of differences between the versions of the KRC and VKRC controllers operating in VW factories. Introduction to the basic functions of RobotStudio off-line robot programming software. Presentation of planning a sample task based on the geometric model of the object. Generating a program ready to be sent to the robot controller. Rules of offline robot program to be transferred and executed on real robot.
Laboratory: Control of industrial robot in manual mode in various coordinate systems. Calibration of the tool and the robot (mastering). Recording and running the program. Interact with external devices. Motion study with approximate positioning. Offline robots programming using the ABB RobotStudio software. Scheduling tasks based on the object's geometric model. Programming ofsignal exchange. Transfer of the program to the real robot and its execution

Course topics

Lecture.
1. Introduction to safety principles at the industrial robot workstation. Presentation of basic tasks performed by robots, taking into account different types of tools.
2. Principles of manual control and program launching, tool calibration using various methods, manipulator calibration (mastering), controller operating modes, kinematic singularities, and the consequences of manipulator motion near a singular configuration, with a simulation presentation in the RobotStudio system.
3. Motion commands and their parameters, precise and approximate positioning, motion planning in the configuration and task (Cartesian) spaces. Principles of proper task planning for manipulator robots. 4. Issues of interaction with external devices through the exchange of input/output signals. Operation of robots sharing a workspace, the principle of area locking. Presentation of sample production programs.
5. Introduction to the basic functions of the RobotStudio offline robot programming system. Presentation of a sample task planning based on a geometric model of the object. Generating a program ready for upload to the robot controller.
6. Basic features of collaborative robots.

Laboratory.
Manual control of an industrial robot in various coordinate systems. Calibrating the tool and robot. Saving

and running the program. Interacting with external devices. Motion testing with approximate positioning. Programming pick and place operations. Offline robot programming using ABB's RobotStudio system. Task planning based on the geometric model of the object. Programming signal exchange. Generating a production program. Programming collaborative robots, taking into account their specific characteristics.

Teaching methods

Lecture: multimedia presentation, illustrated with real-world examples of industrial robot applications. Laboratory: performing exercises using industrial robots Kuka KR200 and ABB IRB 120.

Bibliography

Basic
1. J.J. Craig, Introduction to Robotics. Mechanics and Control, Pearson Education International. 2. Technical documentation regarding Kuka robots and the RobotStudio simulation system
Additional

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	2,00