COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced methods of industrial robot programming and task planing [N2AiR1-RiSA>ZMPRPiPZ]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/3

Area of study (specialization)
Autonomous Robots and 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
20

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 automation and programming of industrial robots. He should also be able to obtain information from specified sources and be willing to cooperate as part of a team.

Course objective

To familiarize students with a dvanced methods of robots tasks planning and programming, including multi-robot tasksdividing the workspace. Theoretical basics illustrated with examples and practical exercises with the use of Kuka KR200 and IRB120 industrial robots and the ABB RobotStudio simulation system. The aim of the course is also to familiarize students with a new class of cooperative robots on the example of UR3 including practical exersises.

Course-related learning outcomes

Knowledge
1. The graduate has an well-structured knowledge of robotics.
2. The graduate has in-depth knowledge related to control and measurement systems.
Skills

1. The graduate has basic exploitation and operator skills of industrial robos.
2. The graduate is able to set models of simple systems and processes, and also use them for the analysis and design of control and robotics systems.
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:

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Lecture: written exam (checking theoretical knowledge) in the advanced methods 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

Introduction: selected examples of technical and medical applications of robot manipulators (DaVinci, RobInHeart).
Application of graphic visualization systems for programming offline robots and task planning on the example of the RobotStudio system. Tool design including calculation of moments of inertia and center of mass.
Advanced functions of programming languages of robots: KRL (Kuka Robot Language) and ABB RAPID at the Expert Programming level. A review of cooperative robots with particular emphasis on UniversalRobot UR robots. Modeling of manipulators' dynamics for use in cooperative robots.

Course topics

Lecture. Introduction: selected examples of technical and medical applications of robot manipulators (DaVinci, RobInHeart).
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RobotStudio system. Tool design including calculation of moments of inertia and center of mass.
Advanced functions of programming languages of robots: KRL (Kuka Robot Language) and ABB RAPID at the Expert Programming level. A review of cooperative robots with particular emphasis on UniversalRobot UR robots. Modeling of manipulators' dynamics for use in cooperative robots. New features of Kuka KRC4 robot controllers. Application of the optimization method (genetic algorithm) for planning the optimal trajectory of robots. Overview of technological packages for the RobotStudio
system.
Laboratory. Programming of Kuka robots at the expert level. Experimental verification of the optimal trajectory based on cycle time. Programming of collision zones. Interact with external devices. Design of robotic station in the ABB Robot Studio system, tool design including parameters for dynamics calculation. Studying the behavior of the manipulator when moving near singular configurations. Programming of UR3 cooperative robots with regard to force interactions.

Teaching methods

Lecture: multimedia presentation, illustrated with real-world examples of industrial robot applications.
Laboratory: performing exercises using industrial robots Kuka KR200 and UR3.

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	80	3,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50