Industrial Robotics

Academic Year: (2023 / 2024) **Review date: 26-04-2023**

Department assigned to the subject: Systems Engineering and Automation Department

Coordinating teacher: OÑA SIMBAÑA, EDWIN DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Introduction to robotics
Fundamentals of electrical engineering
Control engineering I
Linear algebra

OBJECTIVES

By the end of this subject, students will be able to have:
1. Knowledge and understanding of the key aspects and concepts of industrial robotics and control methods
2. Coherent knowledge of their branch of engineering including some at the forefront of the branch in robotics
3. The ability to apply their knowledge and understanding to identify, formulate and solve problems of industrial robotics using established methods.
4. The ability to apply their knowledge and understanding to develop and realise designs of industrial robotics systems to meet defined and specified requirements.
5. An understanding of design methodologies, and an ability to use them in industrial robotics.
6. Technical and laboratory skills.
7. The ability to select and use appropriate equipment, tools and methods in industrial robotics.
8. The ability to combine theory and practice to solve engineering problems of industrial robotics.
9. An understanding of applicable techniques and methods in robotics, and of their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Industrial robotics
1.1 Definition of industrial robotics
1.2 Components of industrial robots
1.3 Design aspects for Flexible Manufacturing Cells based on industrial robots and trends
1.4 Safety in industrial facilities

2. Morphology and robotic technologies
2.1 Structures and basic configurations of robots
2.2 Review of main sub-systems: mechanical
2.3 Review of main sub-systems: actuators and drives
2.4 Review of main sub-systems: sensors
2.5 End effector and tools

3. Kinematic Control
3.1 mathematical tools
3.2 Kinematic modelling
3.3 Forward and inverse kinematic problem formulation and resolution
3.4 Differential modelling
3.5 Trajectories calculus and generation of trajectories
3.6 Kinematic control

4. Dynamic modelling (forces and/or torques)
4.1 Dynamic Control problem formulation
4.2 Euler-Lagrange formulation
4.3 Forward and inverse dynamics main issues

5. Structure of the control system

5.1 Industrial robot controller (description and functionalities)
5.2 I/O devices and industrial communications
5.3 Human-machine interfaces

6. Programming of industrial robots
6.1 Introduction to programming in RAPID (ABB)
6.2 Structure of programs and tasks in RAPID
6.3 Motion instructions and I/O management in RAPID
6.4 Motion and task programming in RAPID
6.5 Advanced programming concepts and methods with RAPID

7. Industrial Robotic Applications
7.1 Case Studies
7.2 Industrial implantation criteria and relevant issues
7.3 Design and simulation of industrial tasks with RobotStudio

LEARNING ACTIVITIES AND METHODOLOGY

THEORETICAL PRACTICAL CLASSES.
Knowledge and concepts students must acquire. Receive course notes and will have basic reference texts. Students partake in exercises to resolve practical problems.

TUTORING SESSIONS.
Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher. Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.

STUDENT INDIVIDUAL WORK OR GROUP WORK.
Subjects with 6 credits have 98 hours/0% on-site.

WORKSHOPS AND LABORATORY SESSIONS.
Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.

Practical sessions will be performed:
1. Getting started with ABB industrial robot manipulators and controllers.
2. Robot programming by demonstration and by RAPID.
3. Robot programming by means of simulation.
4. Robot programming of a simple flexible manufacturing system by means of simulation.

ASSESSMENT SYSTEM

CONTINUOUS EVALUATION
The continuous evaluation will be based on the two partial assessment tests (30% + 30%) and the qualification of a simulation exercise (40%). To habilitate the computation of the simulation work score a minimum of 4 points for the media of the two partial assessments must be obtained in order to calculate the continuous assessment score.

FINAL EXAM
If the student does not pass the continuous assessment shall be submitted to the final exam with a 60% exam and 40% of the simulation work; The simulation work assignment is taken into account for extraordinary call (if presented in Ordinary call)

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Craig, John Introduction to robotics : mechanics and control, Pearson Education, 2014
- Paul, Richard Robot manipulators, mathematics, programming, and control: the computer control of robot manipulators, MIT Press, 1981
- Siciliano, Bruno, Oussama Khatib, and Torsten Kröger Springer handbook of robotics, Springer, 2008

ADDITIONAL BIBLIOGRAPHY

- Peter Corke Robotics, Vision and Control , Springer, 2017