# Industrial Robotics

**Academic Year: ( 2019 / 2020 )** **Review date: 08-05-2020**

**Department assigned to the subject: Systems Engineering and Automation Department**

**Coordinating teacher: GONZALEZ VICTORES, JUAN CARLOS**

**Type: Compulsory ECTS Credits : 6.0**

**Year : 3 Semester : 2**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Algebra
Computer programming (C ,FORTRAN, BASIC)
Control Engineering
Real time computer systems (fundamentals)

## 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. the ability to apply their knowledge and understanding to identify, formulate and solve problems of industrial robotics using established methods;
3. the ability to apply their knowledge and understanding to develop and realise designs of industrial robotics systems to meet defined and specified requirements;
4. an understanding of design methodologies, and an ability to use them in industrial robotics;
5. technical and laboratory skills.
6. the ability to select and use appropriate equipment, tools and methods in industrial robotics;
7. the ability to combine theory and practice to solve engineering problems of industrial robotics;
8. an understanding of applicable techniques and methods in robotics, and of their limitations

## DESCRIPTION OF CONTENTS: PROGRAMME

- 1. Introduction
1.1 Definitions and terms
1.2 Historical evolution
1.3 Industrial Robot market and regulations
1.4 Statistics and trends in Industrial Robots Market

2. Morphology and robotic technologies.
2.1 Structures and basic configurations.
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. Control architecture of Industrial controllers
3.1 Control architecture issues.
3.2 Man-machine interface and communications.
3.3 Controller functionalities.

4. Industrial Robotic Applications.
4.1 Classification.
4.2 Case Studies

5. Kinematic Control
5.1 mathematical tools
5.2 Kinematic modelling
5.3 Direct and inverse kinematic problem formulation and resolution
5.4 Differential modelling
5.6 Trajectories calculus and generation

5.7 Kinematic Control of trajectories.
6. Dynamic modelling
6.1 Dynamic Control problem formulation
6.2 Euler-Lagrange formulation
6.3 Direct and inverse dynamics main issues.
6.2 Dynamic control issues

7. Programming of robots.
7.1 Classification  and Programming methods
7.2 Programming languages for commercial robots
7.3 Coordinate systems and spatial references
7.4 Advanced programming concepts and methods with RAPID (ABB).

8. Industrial implantation criteria and relevant issues.
8.1 Design aspects for Flexible Manufacturing Cells based on industrial robots and trends.
8.2 Safety assurance in Industrial robots
8.3 Introduction to Colaborative Robots.

## LEARNING ACTIVITIES AND METHODOLOGY

- Lectures, classes in small groups, student presentations, tutorials and personal work, oriented towards acquisition of theoretical knowledge (3 ECTS).

- Lab and exercises in small groups, individual tutorials and personal work, especially by final practice proposal related to simulation and programming of a robotised cell; aimed at the acquisition of practical skills related to the program of the course (3 ECTS).

Lab exercises and simulation problems will be done:

1.  Getting started with ABB manipulators and IRC5 controller.
2.  Introduction to Robot Programming by demonstration.
3. Offline Robot Programming by means of Robostudio (first steps).
4. Simulation of a simple robotic manufacturing system (non-presencial workout).

## ASSESSMENT SYSTEM

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 assessment must be obtained in order to calculate the continuous assessment score.

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)

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

## BASIC BIBLIOGRAPHY


- A. Barrientos, L.F. Peñin, C. balaguer, R. Aracil Fundamentos de Robotica (2ª edicion), McGraw Hill.


## ADDITIONAL BIBLIOGRAPHY


- Craig, John J. Introduction to robotics : mechanics and control ,  Pearson Education, 2014
- Paul, Richard P Robot manipulators, mathematics, programming, and control: the computer control of robot manipulators,  MIT Press, 1981