Course guides
220135 - 220135 - Fundamentals of Robotics

Last modified: 29/05/2020

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2020 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Jaume Figueras

Others: Laureano Tinoco
Carlos Trapiello

TEACHING METHODOLOGY

The course is divided into parts:
Theory classes
Laboratory sessions
Self-study (including proposed exercises and activities).

In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding.
In the lab sessions, teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning. Students will be able to robotize a proposed industrial task, working in pairs in the lab, in order to promote contact and use the basic tools needed to solve problems.
Students, independently, need to work on the materials provided by teachers in order to fix and assimilate the concepts. The teachers provide the syllabus and monitoring of activities by ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

The course wants to introduce students to theoretical and practical aspects of the industrial robotics, with special emphasis on the manipulating robots.
Students should after this course know different applications of robotic systems as well as to be able to describe mechanical robotic structures and systems. They should also be familiar with the involved mathematics and with the simple robot control systems.
The main objective of the course is to provide students with the skills and the needed knowledge to use industrial robots in their future professional performance.

STUDY LOAD

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	30,0	40.00

Total learning time: 75 h

CONTENTS

Module 1: Introduction

Description:
1. Brief history
2. Classification of robots
3. Elements of robots, joints, links, actuators, and sensors

Full-or-part-time: 7h 30m
Theory classes: 3h
Self study : 4h 30m

Module 2: Some involved mathematics

Description:
4. Position and orientation of a rigid body
5. Homogeneous transformations
6. Introduction to D-H parameters and its physical significance, orientation of Gripper
7. Direct and inverse kinematics serial robots
8. Examples of kinematics of common serial manipulators.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Module 3: Principles of Robot Control

Description:
9. Planning of trajectory.
10. Calculation of a link velocity and acceleration.
11. Calculation of reactions forces.
12. Trajectory-following control.

Full-or-part-time: 12h 30m
Theory classes: 5h
Self study : 7h 30m

Module 4: Robot Programming

Description:
13. Robot programming methods
14. Robot programming languages
15. Requirements of a programming robots system
The robot as a multitasking system:
- Flow Control
- Task Control

Related activities:
To program a robot in order to robotize a proposed industrial task included in an automated production system.

Full-or-part-time: 35h
Theory classes: 14h
Self study : 21h

Module 5: System integration and robotic applications

Description:
16. Robot system integration.
17. Robotic applications.

Full-or-part-time: 5h
Theory classes: 2h
Self study : 3h

GRADING SYSTEM

Final Exam (written and individual): 45%
Lab work (in groups): 30%
Deliverable exercises: 25%
All those students who can not attend the partial exam, or if you want to improve your result, you will have the option to recover it through an additional written test that will be made the same day fixed for the final examination. The qualification of this test Conversion will be between 0 and 10, and replace the partial exam as long as it is superior.

BIBLIOGRAPHY

Basic:
- Corke, Peter I. Robotics, vision and control : fundamental algorithms in Matlab. 1st ed. New York: Springer, 2011. ISBN 9783642201431.
- Craig, John J. Introduction to robotics : mechanics and control. 3rd ed. Upper Saddle Hall: Pearson Educacion Internacional, cop. 2005. ISBN 0201543613.
- RAPID Reference Manual. System Data Types and Routines On-line [on line]. Västeras: ABB Robotics Products AB, [2013?] [Consultation: 06/05/2020]. Available on: https://library.e.abb.com/public/688894b98123f87bc1257cc50044e809/Technical%20reference%20manual_RAPID_3HAC16581-1_revJ_en.pdf.

Complementary:
- Saha, S. K. Introducción a la robótica. México: McGraw-Hill, 2010. ISBN 9786071503138.
- Fu, K. S; González, Rafael C; Lee, C.S.G. Robótica : Control, detección, visión e inteligencia. Madrid: McGraw-Hill, 1988. ISBN 8476152140.