Course guide
220135 - 220135 - Fundamentals of Robotics

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

Degree:
BACHELOR’S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR’S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (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 TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (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 INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023  ECTS Credits: 3.0  Languages: English

LECTURER

Coordinating lecturer: Jordi Damunt

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 is an introduction to the theoretical and practical aspects of the industrial robotics (industrial manipulators).

In the theory sessions, basic concepts of robotics will be introduced, and in the practical sessions the students will works with industrial robots and simulation software.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Self study</td>
<td>45,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>40.00</td>
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</tbody>
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**Total learning time:** 75 h

### CONTENTS

#### Module 1: Introduction

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

**Full-or-part-time:** 6h 15m  
Theory classes: 2h 30m  
Self study: 3h 45m

#### 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:** 18h 45m  
Theory classes: 7h 30m  
Self study: 11h 15m

#### Module 3: Principles of Robot Control

**Description:**
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: 31h 15m
Theory classes: 12h 30m
Self study : 18h 45m

Module 5: System integration and robotic applications

Description:
17. Robotic applications.

Full-or-part-time: 6h 15m
Theory classes: 2h 30m
Self study : 3h 45m

GRADING SYSTEM

Final Exam (written and individual): 45%
Lab work (in groups): 30%
Deliverable exercises: 25%
All those students who are unable to attend the exam or who want to improve their result will have the option of retaking it by means of an additional written test that will be done on the day set in the calendar for the resumption of optional subjects. The grade for this driving test will be between 0 and 10, and will replace that of the exam as long as it is higher.

BIBLIOGRAPHY

Basic:

Complementary: