Course guides
205241 - 205241 - Autonomous Vehicle Programming

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 INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL 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: 2021 ECTS Credits: 3.0 Languages: English

LECTURER

Coordinating lecturer: Morcego Seix, Bernardo

Others:

TEACHING METHODOLOGY

The theoretical part of the course is developed through lectures including theoretical sessions imparted with the aid of presentations. The applied part is developed with a project-based approach but adapted to the specific traits of the course.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of the course is to acquire a hands-on, panoramic view of the problems and (programmed) solutions in the control system of an autonomous vehicle. Some aspects of this overview are treated in depth. Consequently, there are sub-objectives derived from the main one, which are: to create a functional ROS module in a complex software project, to distinguish and classify the problems in autonomous vehicle guidance and to deal with an introductory problem from other knowledge areas, such as computer vision, artificial intelligence or computer control.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</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>
</table>

Total learning time: 75 h
# CONTENTS

## Module 1: Introduction to AV

**Description:**
1. Autonomous vehicles (definition, autonomy levels, examples, controversies)
2. General description of the AV Control Architecture
3. Sensors and actuators

**Related activities:**
1

**Full-or-part-time:** 2h
Theory classes: 2h

## Module 2: Programming environment

**Description:**
4. Linux OS
5. ROS

**Related activities:**
2

**Full-or-part-time:** 16h
Theory classes: 1h
Self study: 15h

## Module 3: AV Problems and solution

**Description:**
6. Guidance problems
7. Navigation problems
8. Control problems

**Related activities:**
1, 2, 3

**Full-or-part-time:** 57h
Theory classes: 27h
Self study: 30h
# ACTIVITIES

<table>
<thead>
<tr>
<th>1. Theory lectures</th>
</tr>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
</tr>
<tr>
<td>Exposition of the subject theory contents.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
</tr>
<tr>
<td>Knowledge transfer, creation of a conceptual reference frame, solving questions and generating interest about the subject.</td>
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<tr>
<td><strong>Material:</strong></td>
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<tr>
<td>Slide compilations and handouts at Atenea</td>
</tr>
<tr>
<td>General bibliography of the subject</td>
</tr>
<tr>
<td><strong>Delivery:</strong></td>
</tr>
<tr>
<td>This activity is evaluated together with activity 2 and 3.</td>
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<tr>
<td><strong>Full-or-part-time:</strong> 6h</td>
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<tr>
<td>Theory classes: 6h</td>
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<thead>
<tr>
<th>2. Lab project</th>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Students, in groups, follow the instructions to program one of the blocks that make up the control system of an autonomous vehicle. These sessions take place at the lab. A complete, functional program architecture of the autonomous vehicle is given and the objective is to add a new module to this architecture each group.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
</tr>
<tr>
<td>Proper application and programming of problem identification and solving.</td>
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<tr>
<td><strong>Material:</strong></td>
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<tr>
<td>Project instructions at Atenea</td>
</tr>
<tr>
<td>Simulation software (ROS)</td>
</tr>
<tr>
<td>Lab experimental platforms</td>
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<tr>
<td>Course handouts and notes</td>
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<tr>
<td><strong>Delivery:</strong></td>
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<tr>
<td>Programs, working simulations and working experiments.</td>
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<tr>
<td><strong>Full-or-part-time:</strong> 55h</td>
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<tr>
<td>Theory classes: 20h</td>
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<tr>
<td>Self study: 35h</td>
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3. Final demonstration

Description:
Each group explains its project and carries out an experimental demonstration of the behavior of its programmed block.

Specific objectives:
Assess the knowledge acquisition of activities 1, 2.
Refine student assessment within group from the evaluation in activity 2.

Material:
Lab experimental platforms
Presentation assets

Delivery:
Proper working of the programmed block.
Answers to the questions posed during the presentation.

Full-or-part-time: 14h
Theory classes: 4h
Self study: 10h

GRADING SYSTEM

Project assessment – planning: 25%
Project assessment – code development: 25%
Project assessment – presentation: 25%
Project assessment – demo: 25%

BIBLIOGRAPHY

Basic: