320183 - ISCA - Introduction to Advanced Control Systems

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: - Vicenç Puig
Others: - Joseba Quevedo
- Albert Masip
- Damiano Rotondo

Opening hours

Timetable: - Agreed with the students through e-mail.

Prior skills

- Control and automation
- Modelling and analysis of dynamic systems
- Control engineering.

Requirements

- Students should have a background in automatic control.

Degree competences to which the subject contributes

Specific:
1. ELO: skills for The modelling and simulation of systems.
2. ELO: Understanding of automatic control and various control techniques, as well as their application to industrial automation.
3. ELO: Ability to design and control automation systems.

Teaching methodology

The teaching methodology includes:
- Face-to-face theoretical sessions to present the contents of each chapter.
- Face-to-face laboratory sessions to develop projects in a group.
- Self-study work and exercises.

Learning objectives of the subject

- The objective of this subject is to introduce the students advanced subjects of the control area through projects.
- In particular, advanced control techniques will be introduced while showing applications that will illustrate their field of application.
- The course will also introduce techniques that go beyond control such as fault diagnosis and supervision (including tolerant control).

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours small group: 30h</td>
<td>20.00%</td>
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<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
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# Content

## Chapter 1: Advanced Control Systems

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 50h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
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<tr>
<td></td>
<td>Laboratory classes: 10h</td>
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<tr>
<td></td>
<td>Self study: 30h</td>
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### Related activities:
- Activity 1: Theory sessions
- Activity 2: Laboratory sessions

### Specific objectives:
- To understand the need for advanced control techniques beyond standard control techniques to solve complex problems.
- To understand and learn the fundamentals of advanced control techniques in state space.

## Chapter 2: Fault Diagnosis

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 50h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
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<tr>
<td></td>
<td>Laboratory classes: 10h</td>
</tr>
<tr>
<td></td>
<td>Self study: 30h</td>
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### Related activities:
- Activity 1: Theory sessions
- Activity 2: Laboratory sessions

### Specific objectives:
To understand and to know the fundamentals of fault diagnosis techniques as well as the related tasks: fault detection and isolation.
<table>
<thead>
<tr>
<th><strong>Chapter 3: Fault-tolerant control</strong></th>
<th><strong>Learning time:</strong> 50h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 10h</td>
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<tr>
<td>3.1 Data validation</td>
<td>Laboratory classes: 10h</td>
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<tr>
<td>3.2 Data reconstruction</td>
<td>Self study: 30h</td>
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<tr>
<td>3.3 Supervision</td>
<td></td>
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<tr>
<td>3.4 Fault-tolerant control</td>
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</table>

**Related activities:**
- Activity 1: Theory sessions
- Activity 2: Laboratory sessions

**Specific objectives:**
- To understand and learn the fundamentals of data validation/reconstruction, supervision and fault-tolerant control.
Planning of activities

| THEORY SESSIONS | Hours: 75h  
| --- | ---  
| Theory classes: 30h  
Self study: 45h |  

**Description:**
Exhibition of the contents of the subject following an expository and participative class model.

**Support materials:**
- Basic and specific bibliography.
- Notes of the professor (Digital campus).

**Description of the assignments due and their relation to the assessment:**
This activity is evaluated with the projects developed during the lab sessions.

**Specific objectives:**
At the end of these classes, the student must be able to consolidate and acquire the necessary knowledge listed in the section "General learning objectives of the subject".

| LAB SESSIONS | Hours: 75h  
| --- | ---  
| Laboratory classes: 30h  
Self study: 45h |  

**Description:**
- Project 1: Advanced control  
In this project, the students will design an advanced controller for a complex system (autonomous vehicle, UAV or industrial process).
- Project 2: Fault diagnosis  
In this project, the students will design a fault diagnosis system for a complex system (autonomous vehicle, UAV or industrial process).
- Project 3: Advanced control  
In this project, the students will design a fault tolerant controller for a complex system (autonomous vehicle, UAV or industrial process).

**Support materials:**
- Description of the project.
- Bibliography.

**Description of the assignments due and their relation to the assessment:**
Project report developed in a team.

**Specific objectives:**
To apply the concepts presented in the theoretical sessions using real case studies.

Qualification system

- Project 1, weight: 33%
- Project 2, weight: 33%
- Project 3, weight: 33%

All the students that have not pass the subject via the project development, they will have to pass a written final exam.
Regulations for carrying out activities

- All assessment activities are mandatory.
- Students should attend all lab sessions.

Bibliography

Basic:


Complementary:


Others resources:

- Class slides prepared by the professors.
- Exercises and problems of self-learning prepared by teachers.
- Statements and materials to develop the projects.