820130 - TCEE - Control Techniques

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: JOSE MATAS ALCALA
Others: Primer quadrimestre:
JUAN CRUZ VAQUER - T11, T12
JOSE MATAS ALCALA - T11, T12

Degree competences to which the subject contributes

Specific:
1. Understand automatic regulation and control techniques and their application to industrial automation.

Transversal:
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

Teaching methodology
The course uses master classes by 70%, problem analysis in a 20% and work with Matlab by 10%.

Learning objectives of the subject
To study the control of feedback systems, while introducing input-output relationships in the electric and electromechanical systems, along with the time-domain response.

Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group</th>
<th>Hours medium group</th>
<th>Hours small group</th>
<th>Guided activities</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time</td>
<td>150h</td>
<td>45h</td>
<td>0h</td>
<td>0h</td>
<td>90h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15h</td>
<td>0h</td>
<td>60.00%</td>
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</table>
## Content

### Theme 1. Type of systems and modelling of systems

**Learning time:** 4h 30m  
- Theory classes: 2h  
- Laboratory classes: 0h 30m  
- Self study: 2h

**Description:**  
The most common types of physical systems are described and the principles for developing its mathematical modelling are exposed. Also, the equivalence between the different systems is explained.

**Specific objectives:**  
The identification of physic systems  
The modelling of systems  
The understanding of the equivalence between systems.

### Theme 2. Feedback systems.

**Learning time:** 5h 40m  
- Theory classes: 2h  
- Laboratory classes: 1h  
- Self study: 2h 40m

**Description:**  
The concept of feedback systems is introduced, its representation, dynamical properties, stability and response to perturbations are described.

**Specific objectives:**  
Understanding of the achievements of feedback systems  
Understanding the main properties of feedback systems

### Themes 3 to 5. Transient response of 1st and 2nd order systems. Analysis of steady state errors.

**Learning time:** 36h  
- Theory classes: 12h  
- Practical classes: 4h  
- Self study: 20h

**Description:**  
The transient response of first and second order systems for different kind of inputs. The steady state response is also analyzed.

**Specific objectives:**  
Understand to which parameters depend the transient response of first and second order systems.  
Understand the sources of error at steady state and the ways to improve it.
# Qualification system

The evaluation will be conducted through the assessment by the teacher, with the following weights assigned to evaluated activities:
First partial exam: 30%, Second partial exam: 30%, Third partial exam: 23%, Laboratory practice: 17%.
This subject will not have a re-evaluation exam.

## Themes 6 and 7. Root locus. Design of controllers in the LGR domain

<table>
<thead>
<tr>
<th>Description:</th>
<th>The analysis of the evolution of the roots of a system due to feedback is carried out using the root locus method. Controllers as P, PD, PI, PID, lag and lead are designed using the root locus.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific objectives:</td>
<td>Calculate the root locus. Design feedback controllers using the root locus.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>28h 32m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>3h 12m</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study :</td>
<td>23h 20m</td>
</tr>
</tbody>
</table>

## Themes 8 and 9. Bode and Nyquist diagrams

<table>
<thead>
<tr>
<th>Description:</th>
<th>Calculate de Bode diagram and understand the stability criteria using the Nyquist diagram.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific objectives:</td>
<td>Calculate de Bode diagram. Understand the stability criteria in the frequency domain.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>17h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>6h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>1h</td>
</tr>
<tr>
<td>Self study :</td>
<td>10h</td>
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</table>

## Theme 10. Design in the frequency domain of compensators

<table>
<thead>
<tr>
<th>Description:</th>
<th>The controllers P, PI, lead and lag are designed in the frequency domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific objectives:</td>
<td>The design of feedback controllers in the frequency domain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>34h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>12h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study :</td>
<td>20h</td>
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</table>
Regulations for carrying out activities

The attendance to the laboratory sessions is mandatory.

Bibliography

Basic:

Complementary: