820130 - TCEE - Control Techniques

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>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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# 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 1rst 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 le sources of error at steady state and the ways to improve it.
The evaluation will be conducted through the assessment by the teacher, with the following weights assigned to evaluated activities:
First partial exam: 25%, Second partial exam: 32%, Third partial exam: 26%, 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>Learning time: 28h 32m</th>
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<tbody>
<tr>
<td>Theory classes: 3h 12m</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
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<td>Self study: 23h 20m</td>
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</table>

**Description:**
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.

**Specific objectives:**
- Calculate the root locus.
- Design feedback controllers using the root locus.

### Themes 8 and 9. Bode and Nyquist diagrams

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

**Description:**
Calculate de Bode diagram and understand the stability criteria using the Nyquist diagram.

**Specific objectives:**
- Calculate de Bode diagram.
- Understand the stability criteria in the frequency domain.

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

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

**Description:**
The controllers P, PI, lead and lag are designed in the frequency domain.

**Specific objectives:**
The design of feedback controllers in the frequency domain.

### Qualification system

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.

**Specific objectives:**
- Calculate the root locus.
- Design feedback controllers using the root locus.

**Description:**
Calculate de Bode diagram and understand the stability criteria using the Nyquist diagram.

**Specific objectives:**
- Calculate de Bode diagram.
- Understand the stability criteria in the frequency domain.

**Description:**
The controllers P, PI, lead and lag are designed in the frequency domain.

**Specific objectives:**
The design of feedback controllers in the frequency domain.
Regulations for carrying out activities

The attendance to the laboratory sessions is mandatory.

Bibliography

Basic:


Complementary: