820230 - TCEIA - Control Techniques

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control
Academic year: 2018
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Spanish

Teaching staff
Coordinator: José Mª Huerta Sánchez
Others: Beatriz Giraldo Giraldo

Prior skills
Automatic regulation

Requirements
Automatic regulation

Degree competences to which the subject contributes
Specific:
CEEIA-26. Understand automatic regulation and control techniques and their application to industrial automation.

Transversal:
1. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

Teaching methodology
The methodologies used are:
Theoretical sessions (20%), individual working problems (10%) and team-working in laboratory sessions (10%).

Learning objectives of the subject
1. To know and apply the frequencial methods in order to determine the stability and to design compensators.
2. To present the tools for modeling and analysis of discrete time systems.
3. To present methods for design of discrete time systems.
4. To show the possibilities and limitations of computers in the control algorithms implementation.
### Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td><strong>Total learning time</strong>: 150h</td>
<td>45h</td>
<td>30.00%</td>
</tr>
<tr>
<td>Hours large group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>90h</td>
<td>60.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td></td>
<td></td>
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### Content

**1. Stability in frequency domain of continuous time systems.**

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>25h</th>
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<tbody>
<tr>
<td><strong>Theory classes:</strong></td>
<td>7h 30m</td>
</tr>
<tr>
<td><strong>Laboratory classes:</strong></td>
<td>2h 30m</td>
</tr>
<tr>
<td><strong>Self study:</strong></td>
<td>15h</td>
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**Description:**
To know all the graphical methods concerned with frequency response, in order to apply the general stability criterion.

**Related activities:**
Problem solving sessions.

**Specific objectives:**
- Frequency response representations: Bode and polar diagrams.
- Performance specifications in frequency domain.
- Nyquist stability criterion.
- Gain and phase margins.
- Simplified Bode's stability criterion.
- Stability of systems with time delays.

**2. Design and compensation of control systems by frequency methods.**

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>10h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theory classes:</strong></td>
<td>3h</td>
</tr>
<tr>
<td><strong>Laboratory classes:</strong></td>
<td>1h</td>
</tr>
<tr>
<td><strong>Self study:</strong></td>
<td>6h</td>
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</tbody>
</table>

**Description:**
Design of lead compensators andlag compensators using frequency methods.

**Related activities:**
Problem solving sessions.

**Specific objectives:**
- To apply the lag and lead compensation technics.
- To know the advantages and drawbacks of this compensation technics.
### 3. Introduction to digital control of dynamic systems.

**Description:**
To describe the functions and characteristics of the elements and signals belonging to a computer controlled system.

**Related activities:**
Problem solving sessions.

**Specific objectives:**
To consider the effect of the presence of sampled data signals in the control loop and to know the problems associated with the choice of the sampling period, and Shannon’s theorem.

**Learning time:** 10h
- Theory classes: 3h
- Laboratory classes: 1h
- Self study: 6h

### 4. The z-transform.

**Description:**
Introduction to the z-transform in order to represent signals of sampled data systems.

**Learning time:** 15h
- Theory classes: 4h 30m
- Laboratory classes: 1h 30m
- Self study: 9h

### 5. Stability of sampled data systems.

**Description:**
Study of the stability of sampled data systems.

**Specific objectives:**

**Learning time:** 10h
- Theory classes: 3h
- Laboratory classes: 1h
- Self study: 6h

### 6. Design of digital controllers.

**Specific objectives:**

**Learning time:** 30h
- Theory classes: 9h
- Laboratory classes: 3h
- Self study: 18h
### 7. State model of discrete systems.

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>20h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>6h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>12h</td>
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**Description:**
To obtain models of discrete time systems in the state space.

**Specific objectives:**
- State model of discrete systems.
- Discrete time state equation solution.
- Discretization of the state equation of continuous time systems.

### 8. State space control.

<table>
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<tr>
<th><strong>Learning time:</strong></th>
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</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>9h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>3h</td>
</tr>
<tr>
<td>Self study:</td>
<td>18h</td>
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**Specific objectives:**
- Controllability.
- Observability.
- Canonical forms.
- Pole placement by state feedback.
- State observers.

### Qualification system

Partial controls (2): 30%
Last control: 40%
Practices: 15%
Exercises / problems: 15%
Other tests / projects: 35%
Generic competition, self-directed learning, represents 15% of the global evaluation.
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Bibliography

Basic:


Complementary:
