230657 - CTA - Control Theory and Applications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: DOMINGO BIEL, FRANCESC GUINJOAN
Others: ALBERTO POVEDA, EDUARD ALARCÓN

Degree competences to which the subject contributes

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology
- Lectures
- Laboratory classes
- Exercises
- Other activities
- Extended answer test (Final Exam)

Learning objectives of the subject

Learning objectives of the subject:
The aim of this course is to introduce the students in time-domain and frequency-domain methods used to analyse and design linear control systems in both continuous and discrete-time fields.

Learning results of the subject:
- Ability to understand the basic concepts related to feedback system in both continuous-time and discrete-time fields.
- Ability to apply the root locus technique and the Routh stability criteria for the analysis of control systems.
- Ability to design the proper controllers to verify some control specifications in both time-domain and frequency domain.
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 39h</th>
<th>31.20%</th>
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<tr>
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<td>Hours medium group: 0h</td>
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<td>Hours small group: 0h</td>
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<td>Guided activities: 0h</td>
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<td>Self study: 86h</td>
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## 1. Introduction to linear control systems

**Description:**
- Basic components of a control system, reference, control, output and disturbance signals.
- Control system goals.
- Continuous-time control and discrete-time control.
- Dynamic systems classification: linear and nonlinear systems, time-varying and time-invariant systems.
- Transfer function of linear systems.

**Learning time:** 10h
- Theory classes: 2h
- Self study: 8h

## 2. Continuous-time control systems analysis

**Description:**
- Transient and steady-state time-response of linear systems.
- First and second-order systems.
- Transient response characterization: settling time, maximum overshoot, etc.
- Higher order systems: transient response approximation through dominant poles and zero-pole cancellation.
- Routh-Hurwitz stability criteria.
- Root locus analysis.
- Steady-state error.

**Learning time:** 24h
- Theory classes: 6h
- Self study: 18h

## 3. Continuous-time control systems design

**Description:**
- Control design through root locus.
- First and second-order controllers.
- PID controllers.
- Implementation issues of PID controllers.

**Learning time:** 28h
- Theory classes: 6h
- Laboratory classes: 6h
- Self study: 16h
### 4. Analysis of control systems in frequency domain

**Learning time:** 9h  
- Theory classes: 3h  
- Self study: 6h

**Description:**  
- Frequency response of linear systems.  
- Nyquist diagram and Bode diagram.  
- Relative stability: gain margin and phase margin.

### 5. Frequency-domain control design

**Learning time:** 24h  
- Theory classes: 5h  
- Laboratory classes: 2h  
- Self study: 17h

**Description:**  
- Frequency-domain specifications: relative stability margins and bandwidth of a control system.  
- Lead-lag and phase-lag compensations.

### 6. Discrete-time control systems

**Learning time:** 30h  
- Theory classes: 4h  
- Laboratory classes: 5h  
- Self study: 21h

**Description:**  
- Introduction to discrete-time control systems.  
- The Z transform.  
- Z Plane analysis of discrete-time systems.  
- Design of discrete-time control systems by conventional methods.
Planning of activities

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<th>Lectures</th>
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<th>Exercises</th>
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<td>Description: Exercises to strengthen the theoretical knowledge.</td>
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<th>Other activities</th>
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<td>Description: Numerical simulation homework</td>
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<th>Extended answer test (final exam)</th>
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<td>Description: Final examination.</td>
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Qualification system

- Mid course exam (50%)
- Final exam (50%)

Bibliography

**Basic:**


**Complementary:**