Course guides
230924 - CTR - Control Systems

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR’S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).
(Compulsory subject).

Academic year: 2021 ECTS Credits: 6.0 Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: Biel Sole, Domingo
Others: Biel Sole, Domingo Dominguez Pumar, Manuel M.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE26. (ENG) GREELEC: Capacitat per a comprendre i utilitzar la teoria de la realimentació i els sistemes electrònics de control. (Mòdul de tecnologia específica- Sistemes electrònics).

Basic:
CB2. (ENG) GREELEC: Que els estudiants sàpiguen aplicar els coneixements adquirits al seu treball o vocació d'una forma professional i tinguin les competències que solen desmostrar-se per mitjà de l'elaboració i defensa d'arguments i la resolució de problemes dins de la seva àrea d'estudi.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

. To get the capability to set the control specifications.
. To get the ability to design and verify the proper performance of a control system.
. To design the proper controllers to verify specifications in both time domain and frequency domain

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>8.67</td>
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<tr>
<td>Hours large group</td>
<td>52,0</td>
<td>34.67</td>
</tr>
<tr>
<td>Self study</td>
<td>85,0</td>
<td>56.67</td>
</tr>
</tbody>
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Total learning time: 150 h
## CONTENTS

### 1. Introduction

**Description:**
1.1. What is a control system? Basic components of a control system, reference, control, output and disturbance signals.
1.2. Control system goals.
1.3. Continuous-time control and discrete-time control. Examples.

**Full-or-part-time:** 5h  
Theory classes: 2h  
Self study : 3h

### 2. System Modelling

**Description:**
2.1. Dynamic systems classification: linear and nonlinear systems, time-varying and time-invariant systems.
2.2. State space models.
2.3. SISO and MIMO Systems.
2.4. Nonlinear system linearization. Examples.

**Full-or-part-time:** 8h  
Theory classes: 4h  
Self study : 4h

### 3. Dynamic behaviour

**Description:**
3.1. Autonomous and non-autonomous systems.
3.2. Equilibrium points, invariant sets and limit cycles.

**Full-or-part-time:** 19h  
Theory classes: 9h  
Self study : 10h

### 4. Linear Systems

**Description:**
4.1. Linear system state space representation.
4.3. Transfer function for SISO systems.
4.4. First and second-order systems.
4.5. Transient response characterization: settling time, maximum overshoot, etc.
4.7. Routh-Hurwitz stability criteria.

**Full-or-part-time:** 22h  
Theory classes: 9h  
Self study : 13h
5. **State Feedback**

**Description:**
- 5.1. Reachability.
- 5.2. Stabilization by state feedback. Poles-placement design through state feedback. Ackermann’s formula.
- 5.3. Integral action.
- 5.4. Observability.
- 5.5. State observer design.

**Full-or-part-time:** 26h
- Theory classes: 10h
- Self study : 16h

6. **Output Feedback**

**Description:**
- 6.1. Control design in SISO systems through root locus. First and second-order controllers. PID controllers.
- 6.2. Implementation issues of PID controllers.

**Full-or-part-time:** 23h
- Theory classes: 8h
- Self study : 15h

7. **Frequency-domain control design**

**Description:**
- 7.3. Relative stability: gain margin and phase margin.
- 7.4. Frequency-domain specifications: relative stability margins and bandwidth of a control system.
- 7.5. Frequency domain control design. Lead-lag and phase-lag compensations.

**Full-or-part-time:** 21h
- Theory classes: 10h
- Self study : 11h

**Experience 1: Control Systems Introduction**

**Description:**

**Full-or-part-time:** 4h
- Laboratory classes: 2h
- Self study : 2h

**Experience 2: System identification**

**Description:**
- System identification using numerical tools.

**Full-or-part-time:** 4h
- Laboratory classes: 2h
- Self study : 2h
Experience 3: PID controller design

Description:
PID control design implemented by means of electronic circuitry.

Full-or-part-time: 12h
Laboratory classes: 6h
Self study: 6h

Experience 4: Discrete-time control systems introduction

Description:
Discrete-time control systems introduction

Full-or-part-time: 6h
Laboratory classes: 3h
Self study: 3h

GRADING SYSTEM

BIBLIOGRAPHY

Basic:

Complementary: