**Course guides**

**230657 - CTA - Control Theory and Applications**

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

**Degree:**  
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

**Academic year:** 2020  
**ECTS Credits:** 5.0  
**Languages:** English

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**LECTURER**

**Coordinating lecturer:** DOMINGO BIEL, FRANCESC GUINJOAN  
**Others:** ALBERTO POVEDA, EDUARD ALARCÓN

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**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.

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**TEACHING METHODOLOGY**

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

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**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>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>86.0</td>
<td>68.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>39.0</td>
<td>31.20</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

CONTENTS

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.

Full-or-part-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.

Full-or-part-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.

Full-or-part-time: 28h
Theory classes: 6h
Laboratory classes: 6h
Self study: 16h
4. Analysis of control systems in frequency domain

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

Full-or-part-time: 9h
Theory classes: 3h
Self study: 6h

5. Frequency-domain control design

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

Full-or-part-time: 24h
Theory classes: 5h
Laboratory classes: 2h
Self study: 17h

6. Discrete-time control systems

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.

Full-or-part-time: 30h
Theory classes: 4h
Laboratory classes: 5h
Self study: 21h

ACTIVITIES

LECTURES

EXERCISES

Description:
Exercises to strengthen the theoretical knowledge.

OTHER ACTIVITIES

Description:
Numerical simulation homework
EXTENDED ANSWER TEST (FINAL EXAM)

Description:
Final examination.

GRADING SYSTEM

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

BIBLIOGRAPHY

Basic:

Complementary: