Course guide
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: 2022  ECTS Credits: 5.0  Languages: English

LECTURER
Coordinating lecturer: 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>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>
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</tbody>
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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-Hurtwitz 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: