Course guide
230657 - CTA - Automatic Control Theory and Applications

Last modified: 11/05/2022

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

Degree: **Academic year:** 2022 **ECTS Credits:** 5.0
Languages: English

LECTURER

Coordinating lecturer:

Others:

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

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

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:
- Golnaraghi, F.; Kuo, B.C. Automatic control systems. 10th ed. New York: McGraw Hill Education, 2017. ISBN 9781259643835.
- Ogata, K. Modern control engineering. 5th ed. Boston: Pearson, 2010. ISBN 9780137133376.

Complementary:
- Gomáriz, S.; Biel, D.; Matas, J.; Reyes, M. Teoría de control: diseño electrónico [on line]. 2a ed. Barcelona: Edicions UPC, 2000 [Consultation: 04/03/2015]. Available on: http://hdl.handle.net/2099.3/36214. ISBN 8483012669.