Course guides
820230 - TCEIA - Control Techniques

Last modified: 04/06/2021

Unit in charge: Barcelona East School of Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2021 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: JOSÉ MARÍA HUERTA SÁNCHEZ

Others: Primer quadrimestre:
JOSÉ MARÍA HUERTA SÁNCHEZ - T11, T12, T13, T14

Segon quadrimestre:
JOAQUIN BLESA IZQUIERDO - M11, M12, M13, M14
BEATRIZ FABIOLA GIRALDO GIRALDO - M11, M12, M13, M14, M15
JOSÉ MARÍA HUERTA SÁNCHEZ - M11, M12, M13, M14, M15

PRIOR SKILLS

Automatic regulation

REQUIREMENTS

REGULACIÓ AUTOMÀTICA - Prerequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEIA-26. Understand automatic regulation and control techniques and their application to industrial automation.

Transversal:
1. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

TEACHING METHODOLOGY

The methodologies used are:
Theoretical sessions (20%), individual working problems (10%) and team-working in laboratory sessions (10%).

LEARNING OBJECTIVES OF THE SUBJECT

1. To know and apply the frequencial methods in order to determine the stability and to design compensators.
2. To present the tools for modeling and analysis of discrete time systems.
3. To present methods for design of discrete time systems.
4. To show the possibilities and limitations of computers in the control algorithms implementation.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Stability in frequency domain of continuous time systems.

Description:
To know all the graphical methods concerned with frequencial response, in order to apply the general stability criterion.

Specific objectives:
Frequency response representations: Bode and polar diagrams. Performance specifications in frequency domain. Nyquist stability criterion. Gain and phase margins. Simplified Bode's stability criterion. Stability of systems wtih time delays.

Related activities:
Problem solving sessions.

Full-or-part-time: 25h
Theory classes: 7h 30m
Laboratory classes: 2h 30m
Self study : 15h

2. Design and compensation of control systems by frecuencial methods.

Description:
Design of lead compensators and lag compensators using frequenciasl methods.

Specific objectives:
To apply the lag and lead compensation technics.
To know the advantages and drawbacks of this compensation technics.

Related activities:
Problem solving sessions.

Full-or-part-time: 10h
Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

3. Introduction to digital control of dynamic systems.

Description:
To describe the functions and characteristics of the elements and signals belonging to a computer controlled system.

Specific objectives:
To consider the effect of the presence of sampled data signals in the control loop and to know the problems associated with the choice of the sampling period, and Shannon's theorem.

Related activities:
Problem solving sessions.

Full-or-part-time: 10h
Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

4. The z-transform.

Description:
Introduction to the z-transform in order to represent signals of sampled data systems

Full-or-part-time: 15h
Theory classes: 4h 30m
Laboratory classes: 1h 30m
Self study : 9h

5. Stability of sampled data systems.

Description:
Study of the stability of sampled data systams.

Specific objectives:
Mapping between the s-plane and the z-plane. Stability. Extended Routh criterion. Jury's criterion.

Full-or-part-time: 10h
Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

6. Design of digital controllers.

Specific objectives:
Discretization methods. Digital PID controller. Root locus based design. Pole placement in z-plane design. Realization of digital controllers. Effects of finite word length and computacional delay.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

7. State model of discrete systems.

Description:
To obtain models of discrete time systmes in the state space.

Specific objectives:
State model of discrete systems. Discrete time state equation solution. Discretization of the state equation of continuous time systems.

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

8. State space control.

Specific objectives:
Controlability. Observability. Canonical forms. Pole placement by state feedback. State observers.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

GRADING SYSTEM

Partial controls (2): 30%
Last control: 40%
Practices: 15%
Exercises / problems: 15%
Other tests / projects: 35%
Generic competition, self-directed learning, represents 15% of the global evaluation.
The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

BIBLIOGRAPHY

Basic:
- Ogata, Katsuhiko. Sistemas de control en tiempo discreto. 2ª ed. México [etc.]: Prentice Hall Hispanoamericana, cop. 1996. ISBN 9688805394.
- Franklin, Gene F.; Powell, J. David; Emami-Naeini, Abbas. Feedback control of dynamic systems. 6th ed. Upper Saddle River [etc.]: Pearson, 2010. ISBN 9780135001509.
- Phillips, Charles L.; Nagle, H. Troy. Sistemas de control digital : análisis y diseño. 2ª ed. Barcelona [etc.]: Gustavo Gili, 1993. ISBN 8425213355.

Complementary:
- Åström, Karl J.; Wittenmark, Björn. Sistemas controlados por computador. Madrid: Paraninfo, 1988. ISBN 8428315930.
- Kuo, Benjamin C. Digital control systems. 2nd ed. New York ; Oxford: Oxford University Press, cop. 1992. ISBN 0195120647.