Course guide
820230 - TCEIA - Control Techniques

Last modified: 08/08/2024

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: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: BEATRIZ FABIOLA GIRALDO GIRALDO

Others: Primer quadrimestre:
MARÍA DOLORES BLANCO ALMAZÁN - Grup: T11, Grup: T12, Grup: T13, Grup: T14
JOAQUIN BLESA IZQUIERDO - Grup: T11, Grup: T12, Grup: T13, Grup: T14
BEATRIZ FABIOLA GIRALDO GIRALDO - Grup: T11, Grup: T12, Grup: T13, Grup: T14

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 course uses expositive methodology by 20%, an individual class work (problems) by 10%, teamwork (laboratory) by 10%, and non-attendance individual and group work 60%.

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

Total learning time: 150 h

CONTENTS

1. Stability in frequency domain of continuous time systems.

Description:
Know the forms of representation of the frequency response of a system to determine its stability by applying 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 with time delays.

Related activities:
Face-to-face problem sessions.
Problems resolution.
Laboratory practice: experimental obtaining of the frequency response of a real plant and determination of frequency response specifications.

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:
Face-to-face problem sessions.
Problems resolution.
Laboratory practice: design of a phase advance compensator and determination of frequency response specifications.

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:
Face-to-face sessions, examples.
Problems resolution.
Discrete-time control system modeling exercises.

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

Related activities:
Face-to-face sessions, examples.
Problems resolution.
Analysis and simulation of sampled data control systems using MatLab and Simulink

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.

Related activities:
Face-to-face sessions, examples.
Problems resolution.

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

6. Design of digital controllers.

Description:
Study of discretization methods for analog controller and 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.

Related activities:
Face-to-face sessions, examples.
Problems resolution.
Laboratory practice: design controllers using the geometric location of the roots.

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:
Represent a discrete time system in state space. Formulate and solve the equation of state of discrete systems. Know the correspondence between continuous time and discrete time systems in their state variable model representation.

Related activities:
Face-to-face sessions, examples.
Problems resolution.

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

8. State space control.

Description:
Use of the state model of discrete systems for the design of control systems.

Specific objectives:
Design stabilization systems through pole location by feedback of the state vector.
Design monitoring systems from the state representation.
Design state observers.

Related activities:
Face-to-face sessions, examples.
Problems resolution.

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%
Other tests / projects: 15%
It is mandatory to carry out the practices to pass the subject
The assessment of the general competence "Teamwork" corresponds to the marks of the activities done in groups.

In this subject will schedule a reassessment. 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).

EXAMINATION RULES.

The written tests take place within the class schedule.
Practical tests carried out in the laboratory.

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.