Course guide
320034 - EC - Control Engineering

Unit in charge:	Terrassa School of Industrial, Aerospace and Audiovisual 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: 2023   **ECTS Credits:** 6.0   **Languages:** Catalan

LECTURER

Coordinating lecturer:	Fatiha Nejjari Akhi-Elarab
Others:	Ramon Comasòlivas Font.

PRIOR SKILLS

Students will be expected to have the skills taught in Calculus, Linear Algebra, Statistical Methods, Physics, Electrical and Mechanical Systems, Industrial Control and Automation, Programming, and Modelling and Analysis of Dynamical Systems.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. ELO: Understanding of automatic control and various control techniques, as well as their application to industrial automation.

Transversal:
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
4. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

LEARNING OBJECTIVES OF THE SUBJECT

This subject provides students with the necessary theoretical and practical knowledge to do the following:
- Design and implement analogue and digital controllers.
- Analyse and design various industrial control structures.
- Analyse and solve industrial-control problems.

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	20.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

TOPIC 1: CONTINUOUS CONTROL OF DYNAMICAL SYSTEMS

Description:
1.1. Stationary error and system type.
1.2. Sensitivity.
1.3. Disturbance effects.
1.4. Analytical design of regulators.

Specific objectives:
- The ability to define and recognise the effect of an external signal on P, I and D actions.
- The ability to forecast the effect of a change in any control action on the behaviour of a feedback system.
- The ability to calculate the parameters of PID controllers that modify the behaviour of physical systems in order to meet certain operation and disturbance specifications.

Related activities:
Lectures, laboratory practicals and an examination.

Full-or-part-time: 45h
Theory classes: 10h
Laboratory classes: 10h
Self study : 25h

TOPIC 2: DESIGN OF DISCRETE CONTROL SYSTEMS

Description:
2.1. Command-following specifications.
2.2. Effect of disturbances.
2.3. Rejection specifications.
2.4. Internal stability.
2.5. Analytical tuning.

Specific objectives:
The ability to design and implement digital controllers for processes with continuous variables that meet command-following and rejection specifications.

Related activities:
Lectures, laboratory practicals and an examination.

Full-or-part-time: 68h
Theory classes: 14h
Laboratory classes: 14h
Self study : 40h

TOPIC 3: OPERATIONAL ASPECTS OF INDUSTRIAL CONTROLLERS

Description:
3.1. Digital control structures in industry.
3.2. Operational aspects of PID controllers: bumpless and anti-windup.
3.3. Empirical tuning and self-tuning techniques of digital PID parameters.
3.4. Non-linear version of PID controllers.

Specific objectives:
An understanding of automatic control technology with industrial applications.
An understanding of the behaviour of PID controllers.
The ability to tune PID controllers in order to adequately control an industrial process.

Related activities:
Lectures, laboratory practicals and an examination.

Full-or-part-time: 22h
Theory classes: 6h
Laboratory classes: 6h
Self study : 10h

TOPIC 4: AUTOMATIC CONTROL INSTRUMENTS

Description:
4.1. Automatic control instruments.
4.2. Characteristics of the instruments.
4.3. Instrument classes and codes.
4.4. Representation regulations. Analysis and design.
4.5. Current situation of commercial control systems.
4.6. Digital control devices.

Specific objectives:
The ability to analyse and design the various control structures used in current industrial applications.

Related activities:
Lectures, laboratory practicals and an examination.

GRADING SYSTEM

- Midterm exam: 35%
- Final exam: 35%
- Laboratory: 30%

Unsatisfactory results in the first exam (examen parcial) can be recovered by doing a global exam that covers the first and second part of the course. The global exam will be held on the same date and hour scheduled for the final exam of the course. The mark of this global exam may replace the one obtained in the midterm exam if it is higher than this.
All the students, who wish so, can opt for this mechanism by sending an email to the coordinator of the course. Laboratory grades are exempt from this recovering mechanism.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

EXAMINATION RULES.

Attendance and participation in laboratory sessions is compulsory.

BIBLIOGRAPHY

Basic:
- Phillips, Charles L [et al.]. Sistemas de control digital: análisis y diseño. 2ª. Barcelona: Gustavo Gili, 1993. ISBN 8425213355.
- Åström, Karl J. Sistemas controlados por computador. Madrid: Paraninfo, 1988. ISBN 8428315930.
- Ogata, Katsuhiko. Sistemas de control en tiempo discreto. 2a ed. México: Prentice Hall Hispanoamericana, 1996. ISBN 9688805394.
- Shinskey, F. Greg. Process-control systems: application, design, adjustment. 2nd ed. New York: McGraw-Hill, 1979. ISBN 007056891X.

Complementary:
- Smith, Carlos A. Principles and practice of automatic process control. New York: John Wiley & Sons, 1985. ISBN 0471616338.
- Creus Solé, Antonio. Instrumentación industrial [on line]. 8a ed. Barcelona: Marcombo, 2011 [Consultation: 09/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=9767. ISBN 9788426731890.