Course guide
220097 - AUT - Automatic Control

Last modified: 02/04/2024

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 TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: Bachiller Matarranz, Alejandro

Others: Cuguero Escofet, Miquel Àngel
Delgado Prieto, Miguel

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE12-INDUS. Knowledge of the basics of automation and control methods. (Common module in the industrial branch)

Transversal:
CT03 N2. Efficient oral and written communication - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

TEACHING METHODOLOGY

- Sessions display content.
- Sessions for practice.
- Self-study and exercises.
- Preparation and implementation of valuable activities in groups.

The teacher introduce the theoretical fundaments of the subject, concepts, methods and illustrate them with examples appropriate to facilitate understanding.
The students have to study autonomously to assimilate concepts and solve exercises.

LEARNING OBJECTIVES OF THE SUBJECT

· Differentiate between continuous system and discrete system.
· Understand the concept of control in open loop and closed loop.
· Understand the importance of control to improve energy efficiency
· Be able to model physical systems and analyse its time and frequency responses.
· Perform a stability analysis based on the model of the physical system.
· Understand the concept of precision.
· Understand the controllers and being able to design them.

STUDY LOAD

Type	Hours	Percentage
Self study	67,5	60.00
Hours large group	31,0	27.56
Hours small group	14,0	12.44

Total learning time: 112.5 h

CONTENTS

Title Contents 1: Introduction to control systems

Description:
1.1. Motivation.
1.2. Definitions.
1.3. Introduction to continuous systems.
1.4. Control as a tool for improving energy efficiency.

Related activities:
Activity 1: Theory sessions.
Activity 2: Laboratory practices.
Activity 3: Individual evaluation test.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 2h
Self study : 7h

Title Contents 2: Modeling of dynamic systems

Description:
2.1. Laplace transformed and antitransformed
2.2. Differential Equation Solving
2.3. Transfer function
2.4. Blocks diagram
2.5. Block diagram simplification
2.6. Linearization
2.7. Electrical, electronic, mechanical systems and tanks
2.8. Electromechanical systems

Related activities:
Activity 1: Theory sessions.
Activity 2: Laboratory practices.
Activity 3: Individual evaluation test.

Full-or-part-time: 26h
Theory classes: 9h
Laboratory classes: 2h
Self study : 15h

Title Contents 3: Time and frequency responses

Description:
3.1. Temporal response of first and second order systems.
3.2. Response of systems of order higher than 2.
3.3. Dominance
3.4. Frequency response.
3.5. Bode diagram.

Related activities:
Activity 1: Theory sessions.
Activity 2: Laboratory practices.
Activity 3: Individual evaluation test.

Full-or-part-time: 31h
Theory classes: 9h
Laboratory classes: 4h
Self study : 18h

Title Contents 4: Stability and precision

Description:
4.1. Precision.
4.2. Stability in the temporal domain.
4.3. Stability in the frequency domain.

Related activities:
Activity 1: Theory sessions.
Activity 2: Laboratory practices.
Activity 4: Individual evaluation test.

Full-or-part-time: 23h
Theory classes: 7h
Laboratory classes: 2h
Self study : 14h

Title Contents 5: Design and tuning controllers

Description:
5.1. Introduction.
5.2. Classic controllers (P, PI, PD, PID).
5.3. Analytical design by pole assignment.
5.4. Empirical design.

Related activities:
Activity 1: Theory sessions.
Activity 2: Laboratory practices.
Activity 4: Individual evaluation test.

Full-or-part-time: 21h 30m
Theory classes: 4h
Laboratory classes: 4h
Self study : 13h 30m

ACTIVITIES

1. THEORY LESSONS

Description:
Presentation of the contents of the subject following an expository and participatory class model.

Specific objectives:
At the end of these classes, the student must be able to have consolidated and acquired the necessary knowledge listed in the section "General learning objectives of the subject".

Material:
Basic and specific bibliography.
Notes from the teaching staff (ATENEA)

Delivery:
This activity is evaluated with the two written tests: Partial test (act 3) and final test (act 4)

Full-or-part-time: 62h
Self study: 37h
Theory classes: 25h

2. LABORATORY PRACTICE

Description:
Identification of the different control elements. Identification of dynamic systems. Study of the characteristics of the feedback. Study of the effects of the PID controller. Analytical and empirical tuning of PID controllers.

Specific objectives:
- Understanding and mastery of the basic concepts of continuous control.
- Train the student for the synthesis and resolution of problems in the field of industrial control.
- Understanding and mastery of the concepts of modeling and simulation of continuous systems.

Material:
Practice script
Bibliography

Delivery:
Report made in class and answer to an individual written laboratory questionnaire.
Oral communication student / teacher.
30% of the grade for the course.

Full-or-part-time: 34h
Self study: 20h
Laboratory classes: 14h

3. MIDTERM EXAM

Description:
Individual test in the classroom related to the learning objectives of the subject contents

Specific objectives:
Evaluate the general achievement of the objectives of contents 1, 2 and 3

Material:
Statement of the test delivered at the time of the test

Delivery:
The resolved test is delivered to the teacher.
It represents a part of the continuous evaluation of the specific contents of the subject: 35% of the grade for the subject.

Full-or-part-time: 3h
Theory classes: 3h

4. FINAL EXAM

Description:
Individual test in the classroom related to the learning objectives of the subject contents.

Specific objectives:
Evaluate the general achievement of the objectives of contents 3, 4 and 5

Material:
Statement of the test delivered at the time of the test.

Delivery:
The resolved test is delivered to the teacher.
It represents a part of the continuous evaluation of the specific contents of the subject: 35% of the grade for the subject.

Full-or-part-time: 3h
Theory classes: 3h

5. DIRECTED ACTIVITIES, WRITTEN AND ORAL COMMUNICATION.

Description:
Through this activity, the generic competence effective oral and written communication will be exercised and evaluated.

The teacher tutors the students in a small group, with the objective that these, in groups of 2 "guide students" are able to:

· Effectively plan oral and written communication.
· Write texts with a sufficient level of spelling and grammar correction, as well as with adequate scientific and technical rigor.
· Communicate and transmit this information to their own classmates in their corresponding group (small, laboratory).

With the materials, explanations and orientations of the "guide students", your fellow students should be able to understand and carry out the labs.

Material:
- Practice script.
- Help sheets for practicals, specific to the models and the laboratory.
- Generic support material: basic and specific bibliography, teacher's notes (Athena).

Delivery:
For the evaluation of the activity of the "guide students" the questionnaire that the classmates themselves answered in this regard will be taken into account.

Full-or-part-time: 10h 30m
Self study: 10h 30m

GRADING SYSTEM

- 1st Theory exam: 35%
- 2nd Theory exam: 35%
- Evaluation of the practical by examination: 10%
- Continuous assessment practices: 20%

The course will provide for procedures to recover unsatisfactory results. Concretely, the unsatisfactory results obtained from the first exam of theory could be recover by the second theory exam. The obtained qualification of the 2nd theory exam could replace the obained by the first exam, in the case in which the qualification of the second theory exam be higher than the first one. All students will be entitled to this reconduction.

BIBLIOGRAPHY

Basic:
- Ogata, Katsuhiko. Ingeniería de control moderna [on line]. 5a ed. Madrid: Pearson Educación, 2010 [Consultation: 19/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259. ISBN 9788483229552.
- Villà, Ricard. Apunts de dinàmica de sistemes [on line]. Barcelona: UPC, 2019 [Consultation: 23/04/2024]. Available on: https://sites.google.com/site/ricardvilla/apunts-dinamica-de-sistemes. ISBN 84893490967.

Complementary:
- Dorf, R. C. Sistemas de control moderno. 10a ed. Madrid: Prentice Hall, 2005. ISBN 8420544019.
- Åström, Karl J. Feedback systems : an introduction for scientists and engineers. Princeton: Princeton University, 2008. ISBN 9780691135762.
- Goodwin, Graham C. Control system design. Upper Saddle River: Prentice-Hall, 2001. ISBN 0139586539.