Course guide
330106 - RA - Automatic Regulation

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Escobet Canal, Teresa

Others: Leon Pardo, Miguel

PRIOR SKILLS

Students are expected to have passed Mathematics I and II, Fhysics I and II, Introduction to Computing, Mechanical Systems, Electrical Systems, Electronic Systems and Industrial Control and Automation

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge of frequency-domain analysis properties for designing feedback controllers for both continuous and discrete time systems.
2. Knowledge of space state techniques for modeling complex systems.
3. Modelling and simulating dynamic systems.
4. Knowledge applied to discrete time systems.
5. Ability to synthesize and solve problems related to the automatic control discipline.

Transversal:
6. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
7. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
8. 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.
08 GEN. GENDER PERSPECTIVE: An awareness and understanding of sexual and gender inequalities in society in relation to the field of the degree, and the incorporation of different needs and preferences due to sex and gender when designing solutions and solving problems.

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:
- Build mathematical and simulation models corresponding to real systems and use them to study and analyse the dynamic behaviour of the systems.
-Design and implement analogue and digital controllers.
- Analyse and solve industrial-control problems.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Topic 1. MODELLING AND ANALYSIS OF DINAMIC SYSTEMS

Description:
1.1. Introduction and presentaction of the study cases
1.2. Tools for simulating mathematical models.
1.3. Temporal analysis of continuous dynamical systems
1.4. Frequency analysis of continuous dynamical systems
1.5. Discrete systems analysis

Specific objectives:
The ability to create unified mathematical models for various types of systems.
The ability to represent dynamical system using state space techniques.
The ability to use tools to simulate systems on the basis of their models.
The ability to define and calculate the time-response characteristics of a feedback system exposed to external signals and disturbances.
The ability to define and calculate the various frequency-response characteristics of a feedback system.
The ability to mathematically represent mixed (continuous and discrete) dynamical Systems.
The ability to understand the differences between a continuous system and a discrete system.

Related activities:
Lectures, laboratory practicals and examinations.

Full-or-part-time: 22h
Theory classes: 18h
Practical classes: 4h

Topic 2. CONTINUOUS CONTROL OF DYNAMICAL SYSTEMS

Description:
2.1. Command-following specifications
2.2. Analytical design of regulators
2.3. Frequential 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: 19h
Theory classes: 15h
Practical classes: 4h

TOPIC 3. DESIGN OF DISCRETE CONTROL SYSTEMS

Description:
3.1. Introduction to digital controller
3.2. Command-following specifications
3.3. 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: 19h
Theory classes: 15h
Laboratory classes: 4h

ACTIVITIES

ACTIVITY 1: EXPLANATORY SESSION

Description:
Sessions that combine master classes, where theoretical concepts are explain, with exercice and problem resolution.

Material:
Matlab Program.
Matlab tutorial.
Collection of problems of the subject.
Basic Bibliography.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 2: PROBLEM SESSION

Description:
They are face-to-face classes specifically dedicated to problem solving. They are made in the laboratory, as the Matlab is available to obtain the solution. They are classes that require the participation of students, as they will solve the problems in group and / or individually.

Material:
Matlab Program.
Matlab tutorial.
Collection of problems of the subject.

Full-or-part-time: 33h
Laboratory classes: 13h
Self study: 20h

ACTIVITY 3: EVALUATION

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

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

Full-or-part-time: 46h
Theory classes: 6h
Self study: 40h

ACTIVITY 4: SOLVING EXERCISES

Description:
It is an activity that the student does autonomously and consists in solving problems that have been proposed in class.

Material:
Statements delivered in each case.
Matlab Program.
Basic Bibliography.

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

GRADING SYSTEM

Each student's final mark is obtained by weighting his/her marks on the following:
1. Two control tests performed throughout the course with a weight of 20% each.
2. Continuous assessment in laboratory sessions, with a weight of 25%.
3. A final evaluation test with a weight of 35%.

EXAMINATION RULES.

Attendance and participation in laboratory sessions is compulsory.

BIBLIOGRAPHY

Basic:
- Nise, Norman S. Control systems engineering. 7th ed. Hoboken: John Wiley & Sons, 2015. ISBN 9781118800829.

Complementary:
- Bolzern, Paolo; Scattolini, Riccardo; Schiavoni, Nicola. Fundamentos de control automàtico. 3ª ed. Madrid: McGraw-Hill, 2008. ISBN 9788838664342.
- Ogata, K. Ingeniería de control moderna [on line]. 5ª ed. Madrid: Pearson Educación, 2010 [Consultation: 02/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259. ISBN 9788483226605.