Course guide
820228 - REGA - Automatic Regulation

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: 2022  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER
Coordinating lecturer: BEATRIZ FABIOLA GIRALDO GIRALDO
Others:
Primer quadrimestre:
BEATRIZ FABIOLA GIRALDO GIRALDO - ABE T ORRES CEBRIAN -

Segon quadrimestre:
BEATRIZ FABIOLA GIRALDO GIRALDO - ABE T ORRES CEBRIAN -

PRIOR SKILLS
Electrical systems, mechanical systems, Mathematics III

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
CEEIA-25. Model and simulate systems.

Transversal:
2. 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.
3. EFFECTIVE USE OF INFORMATION 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.

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
At the end of the course the student will be able to:
1. To acquire basic skills in modeling dynamic systems.
2. To define and know how to apply the general methods of systems analysis.
3. To define and know how to apply the general methods of designing control systems in continuous time.
4. To know how to configure and tune different types of controllers used in the industry.
5. Teamwork.
6. Manage information resources in the field of control systems.
## STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15.0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>45.0</td>
<td>30.00</td>
</tr>
</tbody>
</table>

**Total learning time:** 150 h

## CONTENTS

### 1. Introduction to feedback control systems

**Description:**

**Specific objectives:**
- Define different types of physical systems and signals.
- Understand and know how to differentiate the terminology of control systems and their definitions.
- Know how to use the appropriate transformation methods for each type of signal.
- Know the advantages and disadvantages of systems with feedback.

**Related activities:**
- Face-to-face sessions, examples of systems
- Problems resolution
- Laboratory practice: simulation of control systems.

**Full-or-part-time:** 10h
Theory classes: 3h
Practical classes: 2h
Self study: 5h
2. Models of dynamic systems

Description:

Specific objectives:
- Apply the generalizing concept of a dynamic system to a real physical system.
- Establish the hypotheses necessary to characterize the system in a simplified way.
- Apply physical laws to obtain a mathematical model of a system.
- Express this model in the form of a transfer function or a state variable model.
- Convert the model of a given system as a transfer function to a state variable model, and vice versa.

Related activities:
- Face-to-face sessions, examples of systems.
- Problems resolution
- Laboratory practice: Analysis of different control systems through simulation

Full-or-part-time: 30h
Theory classes: 7h 30m
Laboratory classes: 2h
Self study: 20h 30m

3. Analysis of time domain systems

Description:

Specific objectives:
- Systematically analyze temporal response of first and second order systems to standard test signals.
- Classify the responses of these systems based on previously defined specifications, which can be measured in a simple way, and which allow an assessment of the system’s performance to be obtained.
- Establish a correlation between the location of the poles of the system and its transient response.
- Calculate the steady state error in a control system.
- Solve the state equation of a dynamic system.
- Define error rates to be able to quantitatively express the performance of a system.

Related activities:
- Face-to-face sessions, examples of systems.
- Problems resolution.
- Laboratory practice: Simulation systems using the "State Variable" model.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study: 18h
4. Stability of linear systems

Description:

Specific objectives:
- Propose procedures to follow to determine the stability of dynamic systems.
- Determine the stability of linear systems, based on their transfer function model or their state variable model.

Related activities:
- Face-to-face sessions, examples.
- Problems resolution.
- Laboratory practice: Study of a speed and position control servosystem. Cascade control.

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

5. Root locus method

Description:
Concept of the root locus. Application of the root locus method to the analysis and design of control systems.

Specific objectives:
- Know how to use the root locus method as a technique to determine specifications of the dynamic system when a parameter varies.
- Apply this method to analyze and design control systems.

Related activities:
- Face-to-face sessions, examples.
- Problems resolution.
- Laboratory practice: Temperature control with a PID regulator.

Full-or-part-time: 10h
Theory classes: 3h
Laboratory classes: 2h
Self study: 5h
### 6. Controllers

**Description:**

**Specific objectives:**
- Define the basic control actions, P, I and D, as well as the combined control actions.
- Identify which are the most appropriate control actions for a particular type of process.
- Identify which modifications of the standard PID regulator occur in practice, as well as their usefulness.
- Know how to tune a PID controller for a given process, by empirical and analytical methods.
- Distinguish between the different types of nonlinear controller used in control systems, knowing qualitatively the type of response they produce.

**Related activities:**
- Face-to-face sessions, examples.
- Problems resolution.
- Laboratory practice: Application of an industrial controller to the control of a real process.

**Full-or-part-time:** 40h
- Theory classes: 10h 30m
- Laboratory classes: 3h
- Self study : 26h 30m

---

### GRADING SYSTEM

Partial controls (2): 30%
Last control: 40%
Practices: 15%
Others test/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:**

**Complementary:**