



# Course guide

## 280675 - 280675 - Regulation and Automatic Control

Last modified: 09/05/2023

**Unit in charge:** Barcelona School of Nautical Studies  
**Teaching unit:** 707 - ESAII - Department of Automatic Control.

**Degree:** BACHELOR'S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 4.5    **Languages:** Catalan, Spanish

### LECTURER

**Coordinating lecturer:** SERGIO ROMERO LAFUENTE

**Others:** Segon quadrimestre:  
SERGIO ROMERO LAFUENTE - GESTN

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**

1. Knowledge of the theory of automatic control methods and their application on board.

### TEACHING METHODOLOGY

- Receive, understand and synthesize knowledge
- Consider and solve problems
- Analyze results
- Perform work in a team and individually

### LEARNING OBJECTIVES OF THE SUBJECT

The main objective is to provide the concept of a dynamic system, applicable in practically all fields of engineering, and the signal as a variable of this system. Other objectives include:

- Introduction to the basic concepts and tools of system analysis.
- Design of controllers to improve the performance specifications of the systems.
- Presentation of control systems within the naval field.

At the end of the course the student must be able to perform the analysis and modification of the systems behavior in naval technology.

### STUDY LOAD

| Type               | Hours | Percentage |
|--------------------|-------|------------|
| Guided activities  | 6,0   | 5.33       |
| Hours small group  | 9,0   | 8.00       |
| Hours medium group | 15,0  | 13.33      |
| Self study         | 67,5  | 60.00      |
| Hours large group  | 15,0  | 13.33      |

**Total learning time:** 112.5 h



## CONTENTS

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### Introduction to automatic

**Description:**

Objective and scope of the subject. Feedback systems. Examples of dynamic systems in a ship.

**Full-or-part-time:** 3h 30m

Theory classes: 1h 30m

Self study : 2h

### System modeling

**Description:**

Transfer function of linear systems. Canonical gain, poles and zeros. Block diagrams. Block algebra.

**Full-or-part-time:** 13h 45m

Theory classes: 3h 30m

Practical classes: 2h

Self study : 8h 15m

### Time response

**Description:**

Impulse and step responses of first and second order systems. Stationary error of feedback systems.

**Full-or-part-time:** 22h 30m

Theory classes: 6h

Practical classes: 3h

Self study : 13h 30m

### System stability

**Description:**

Definition of stability. Necessary and sufficient condition. Routh criterion.

**Full-or-part-time:** 9h 15m

Theory classes: 2h

Practical classes: 2h

Self study : 5h 15m



### Design of PID controllers

**Description:**

PID controllers. Basic control actions. Effect of the actions of the P, I and D controls. Design of PID controllers.

**Related activities:**

Lab 1: Introduction and control system of the angular velocity of a DC motor. In this session the student has to: 1) Understand the system and the function of the different blocks of the plant; 2) Identify the model of the plant; 3) Evaluate the performance of different control systems in open and closed loop; and 4) Understand the effect of the different actions of proportional, integral and derivative controls.

Lab 2: Control system for the angular position of a DC motor. In this session the student has to: 1) Evaluate the performance of different systems in open and closed loop; and 2) Design a PID controller.

**Full-or-part-time:** 22h 15m

Theory classes: 2h

Practical classes: 3h 30m

Laboratory classes: 4h

Guided activities: 6h

Self study : 6h 45m

### Frequency response

**Description:**

Gain and phase. Bode diagram. Frequency response of the canonical elements. Bode diagram of a general system. Polar diagram.

**Full-or-part-time:** 27h 30m

Theory classes: 7h

Practical classes: 4h

Self study : 16h 30m

### Stability in the frequency domain

**Description:**

Nyquist criterion. Gain and phase margins.

**Full-or-part-time:** 13h 45m

Theory classes: 3h 30m

Practical classes: 2h

Self study : 8h 15m



## GRADING SYSTEM

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The final mark is the partial sum of the following qualifications:

$N_{\text{final}} = 0.45 N_{\text{pf}} + 0.4 N_{\text{ac}} + 0.15 N_{\text{el}}$

$N_{\text{final}}$ : Final result

$N_{\text{pf}}$ : Final exam qualification

$N_{\text{ac}}$ : Continuous evaluation

$N_{\text{el}}$ : Laboratory qualification

The final exam consists of questions on concepts associated with the learning objectives of the course, and a set of practice exercises. Continuous evaluation is the result of a partial test (with a weight of 20% of the final mark) and activities conducted during the year.

Reexamination: According to the rules of the FNB, a reexamination test consisting of a comprehensive review of the subject will be performed. This test reassessment is aimed to students with a final mark ranging between 3.0 and 4.9.

## EXAMINATION RULES.

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· Students who do not submit the final test, or have not done any of the labs, or have not submitted any test of the continuous evaluation will be denoted as "NOT TAKEN".

## BIBLIOGRAPHY

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### Basic:

- Ogata, Katsuhiko. Ingeniería de control moderna [on line]. 5a ed. Madrid: Pearson Educación, 2010 [Consultation: 01/09/2022]. Available on: [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=1259](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1259). ISBN 9788483226605.

### Complementary:

- Dorf, Richard C. Sistemas automáticos de control: teoría y práctica. Mexico: Addison Wesley Iberoamericana, 1986. ISBN 9688580449.

## RESOURCES

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### Other resources:

Notes of theory and problems of the subject (Digital Campus Atenea).