Course guide
340732 - REAC - Automatic Regulation and Digital Control

Last modified: 17/07/2026

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING AND RAILWAY SYSTEMS (Syllabus 2024). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Duarte Mejía, Josué Neftalí

Others: Duarte Mejía, Josué Neftalí
Chico Villegas, José Pascual

PRIOR SKILLS

It is highly advisable to have completed and passed the subject of Fundamentals of Automation.

TEACHING METHODOLOGY

Face-to-face training activities
· Participatory expository classes
· Individual and team exercises
· Realization of team laboratory practices
· Realization of team projects
· Writing reports and oral defense of problems, practices and projects carried out

Non-face-to-face training activities
· Realization of exercises and theoretical or practical projects outside the classroom, individually and/or in groups.
· Review of theoretical concepts, study, work and individual or group analysis
· Tutoring and formative evaluation of the learning process

LEARNING OBJECTIVES OF THE SUBJECT

The aim of this course is to provide basic knowledge of linear control systems description in discrete time in order to be able to design some discrete controllers.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Module 1: Introduction to control systems in discrete time

Description:
Objective
The aim of this first module is to introduce the basic architecture of digital control systems, applicability and benefits of their use.

Subsections:
* Types of signals
* Digital control systems
* DAC and ADC converters
* Supervisor control vs direct digital control
* Advantages of digital control vs analogic control

Full-or-part-time: 18h
Theory classes: 6h
Self study : 12h

Module 2: Mathematical models in discrete time

Description:
Objective
The aim of this second module is to present the mathematical tools that are used to analyze control systems in discrete time. Will relate these techniques with the techniques used to analyze continuous systems.
Content

* Z transform definition and properties
* Methods of calculating the Z transform and its inverse

Specific objectives:

Full-or-part-time: 18h
Theory classes: 6h
Self study : 12h

Module 3: Signal sampling and reconstruction

Description:
Content:
* Ideal sampling or impulse sampling
* Sampled signal spectrum. Shannon Theorem. Ideal filter
* 0 and 1 order holder
* Star transform
* Empiric rule

Full-or-part-time: 18h
Theory classes: 6h
Self study : 12h

Module 4: Discrete transform function

Description:
Content:
* Equivalent discrete transform function
* Blocs diagrams. Simplification

Full-or-part-time: 24h
Theory classes: 8h
Self study : 16h

Module 5: Time response and stability

Description:
Content:
* Relation betwenn s and z plains
* Routh stability criterion (bilinear transform)
* Jury stability criterion
* steady state error in discrete systems

Full-or-part-time: 18h
Theory classes: 6h
Self study : 12h

Module 6: Discrete controllers design

Description:
Content:
* Design of conventional controllers in s plane
* Discretization of continuous controllers
* Design of discrete controllers in z plane

Full-or-part-time: 42h
Theory classes: 14h
Self study : 28h

GRADING SYSTEM

A non-eliminatory midterm exam (P) will be administered halfway through the semester, followed by a final exam (F) at the end of the semester. The grade for the theory and problem-solving portion of the course is calculated using the formula: T = max(0.5·(P+F), F). For the laboratory component, there will be a midterm exam (LP) and a final exam (LF). The laboratory grade is calculated as: L = 0.5·LP + 0.5·LF. The final grade is calculated using the formula: 0.65·T + 0.35·L. All students with a final grade between 2 and 4.9 are eligible to retake the course. The retake (R) replaces the grade (F), and once completed, the final grade is calculated as: max(7, 0.65·TR + 0.35·L), where: TR = max(R, (P+R)/2).

EXAMINATION RULES.

In the exams, the official form of the subject can be used. An authorship control of all the written tests can be carried out.

BIBLIOGRAPHY

Basic:
- Ogata, Katsuhiko. Sistemas de control en tiempo discreto . 2ª ed. México [etc.] : Prentice Hall Hispanoamericana, cop. 1996. ISBN 9688805394.
- Phillips, Charles L; Nagle, H. Troy; Chakrabortty, Aranya. Digital control system analysis & design . Fourth edition. Boston : Pearson Prentice Hall, 2015. ISBN 9781292061887.