



# Course guide

## 230051 - CDA SISTEL - Advanced Digital Communications

**Last modified:** 08/07/2025

**Unit in charge:** Barcelona School of Telecommunications Engineering  
**Teaching unit:** 739 - TSC - Department of Signal Theory and Communications.

**Degree:** BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** Catalan, Spanish, English

### LECTURER

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**Coordinating lecturer:** ANTONIO PASCUAL ISERTE - GREGORIO VAZQUEZ GRAU

**Others:**

Primer quadrimestre:  
ANTONIO PASCUAL ISERTE - 40

Segon quadrimestre:  
GREGORIO VAZQUEZ GRAU - 10

### PRIOR SKILLS

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- ALED (linear algebra): Determinant of Matrices and systems of equations. Inverse. Matrix Operations. Vector Spaces and subspaces. Subspace spanned by a set. Linear combination and linear independence. Dimension. Basis. Coordinates of a vector in a base. Base change.
- ACAL (calculus): Scalar product and topology: norm and distance. Conditional and unconditional optimization. Lagrange multipliers.
- PPEE (probability and stochastic processes): full syllabus.
- SSIS (signals and systems): Signals and systems in time and frequency domain. Fourier transform.
- ICOM (introduction to communications): full syllabus.

### REQUIREMENTS

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INTRODUCTION TO COMMUNICATIONS - Precorequisite

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Transversal:**

07 AAT N3. 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.

### TEACHING METHODOLOGY

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Application classes  
Lecture classes  
Group work (at home)  
Individual work (at home)  
Long answer exams and/or tests (Control(s))  
Long answer exams and/or tests (Final Exam)

## LEARNING OBJECTIVES OF THE SUBJECT

- Be able to build, operate and manage networks, services, processes and telecommunications applications from the point of view of the transmission systems.
- Know when to apply the techniques are based networks, services and applications in both telecommunications fixed and mobile environments, personal local or long distance, with different bandwidths, including telephony, radio, television and data from the point of sight transmission systems.
- Plan and use the information needed for a project or academic work from a critical appraisal of the information resources used.
- Apply the skills acquired in carrying out a task independently. Identify the need for continuous learning and develop the own strategy to do so.
- Identify, model, and raise problems from open situations. Explore alternatives and apply them for its resolution. Use approaches.
- Identify and model complex systems. Perform analysis and qualitative approaches, establishing the uncertainty of the results.
- Raise hypotheses and experimental methods to validate. Identify the main components and establish commitments and priorities.

Learning outcomes:

The student must finish the course having acquired the following skills:

- Analysis and design of a digital communications system.
- Characterization of the basic elements and their functions.
- Transmission of information generated by a source in digital format.
- Physical characteristics of the channel and its influence on the design of a communications system.
- Linear digital modulations and orthogonal modulations.
- Access techniques.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	65,0	43.33
Self study	85,0	56.67

**Total learning time:** 150 h

## CONTENTS

### Chapter 0. Introduction

**Description:**

Presentation of the subject.

**Full-or-part-time:** 2h

Theory classes: 2h

### Chapter 1. Fundamentals of Digital Communications

**Description:**

- Transmission in AWGN channels.
- The channel response.
- Multicarrier modulations. OFDM and SC-FDMA.

**Full-or-part-time:** 75h

Theory classes: 29h

Self study : 46h

## Chapter 2. Frequency Flat-Fading Channels and Diversity Methods

### Description:

- Channel state information (CSI) concept.
- Fast fading channels.
- Slow fading channels.
- Space-time coding.
- MIMO channel models.

### Full-or-part-time: 51h

Theory classes: 22h

Self study : 29h

## Chapter 3. Spread Spectrum

### Description:

- Objectives in spread spectrum modulations.
- Fast and slow frequency hopping: indoor communications.
- Direct-Sequence Code Division Multiple Access (DS-CDMA).

### Full-or-part-time: 17h

Theory classes: 7h

Self study : 10h

## ACTIVITIES

### Mid-term exam(s)

### Description:

Mid-term exam(s)

### Full-or-part-time: 2h

Theory classes: 2h

### Final exam

### Description:

Final exam

### Full-or-part-time: 3h

Theory classes: 3h

## GRADING SYSTEM

- Continuous evaluation (40%): it will be based on one or several partial exams and/or the delivery of exercises according to the professor's criteria.
- Final exam (60%): global exam covering all the contents of the subject.

In case that the mark of the final exam is better than the mark of the continuous evaluation, the global mark of the subject will be the mark of the final exam.



## BIBLIOGRAPHY

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### Basic:

- Lapidoth, Amos. A Foundation in Digital Communication [on line]. 2nd ed. Cambridge: Cambridge University Press, 2017 [Consultation: 16/07/2025]. Available on: <https://www-cambridge-org.recursos.biblioteca.upc.edu/core/books/foundation-in-digital-communication/05F46005A017815C49810D51CFDB9B8F>. ISBN 9781316822708.
- Tse, David; Viswanath, Pramod. Fundamentals of Wireless Communication. Cambridge: Cambridge University Press, 2005. ISBN 9780521845274.
- Madhow, Upamanyu. Introduction to Communication Systems. Cambridge, United Kingdom: Cambridge University Press, 2015. ISBN 9781107022775.
- Madhow, Upamanyu. Fundamentals of Digital Communication. Cambridge; New York: Cambridge University Press, 2008. ISBN 9780521874144.
- Artés Rodríguez, Antonio; Pérez González, Fernando. Comunicaciones Digitales. Madrid: Pearson Educación/Prentice Hall, cop. 2007. ISBN 8483223481.
- Proakis, John G; Salehi, Masoud. Digital Communications. 5th ed. Boston [etc.]: McGraw-Hill, cop. 2008. ISBN 9780072957167.

### Complementary:

- Ouyang, Feng. Digital Communication for Practicing Engineers. 1st ed. United States of America: Wiley-IEEE Press, 2019. ISBN 9781119418009.
- Gallager, Robert G. Principles of Digital Communication [on line]. Cambridge; New York: Cambridge University Press, 2008 [Consultation: 08/07/2025]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=336113>. ISBN 9780521879071.
- Goldsmith, Andrea. Wireless Communications [on line]. Cambridge; New York: Cambridge University Press, 2005 [Consultation: 08/07/2025]. Available on: <https://www-cambridge-org.recursos.biblioteca.upc.edu/core/books/wireless-communications/800BA8A8211FBECB133A7BB77CD2E2BD>. ISBN 0521837162.