Course guide
300519 - FC-S - Fundamentals of Communications

Last modified: 27/01/2026

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

Degree: BACHELOR'S DEGREE IN SATELLITE ENGINEERING (Syllabus 2024). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura

Others: Definit a la infoweb de l'assignatura

PRIOR SKILLS

- Operations with complex numbers.
- Fourier transforms and Fourier series. Knowledge of the time–frequency relationship of signals. Frequency shifting, delay, etc.
- Calculation of instantaneous power and average power.
- Units (W, dBW, dBm, dB).
- Power spectral density.
- Basic trigonometric relationships.
- Probability, discrete and continuous random variables, calculation of expectation, variance, and second-order moment.

TEACHING METHODOLOGY

In the weekly classes, both theoretical and problem-solving sessions are held. In the theoretical classes, the main concepts and the most important results are presented, with examples that help their understanding. In the problem-solving sessions, purely operational exercises are carried out, as well as problems similar to real practical cases.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge
K1. Identify the elements of telecommunication systems and the fundamental concepts and laws of electromagnetic propagation, modulation, multiplexing and signal processing, control and synchronization in satellite communications.

Skills
S1. Apply the most appropriate modulation schemes and multiple access techniques in satellite communications.
S2. Evaluate a satellite communication system.

Competencies
C1. Carry out tasks and projects for the development of satellite networks and their communications, individually or as part of a group, in accordance with a set of initial requirements.

At the end of the Fundamentals of Communication course, the student should be able to:

Understand the functional blocks that make up a communication system.
Operate with modulated signals in the frequency and time domains.
Study and calculate the parameters of analog and digital communications.
Study the basic quality criteria in communication systems (signal-to-noise ratio and error probability).
Understand signal multiplexing techniques.
Understand multiple access techniques.
Understand basic channel coding techniques (error detection and correction systems).
Understand advanced digital signal modulation mechanisms, especially suitable for radio environments, and be able to analyze and design systems based on these mechanisms.
Understand multicarrier transmission techniques, especially OFDM, their technical characteristics and parameters, as well as their advantages, limitations, and implementation complexities. The student should be able to dimension a radio link based on these techniques, properly configure its operating parameters, and evaluate its performance.
Understand the main spread-spectrum transmission techniques, especially those based on CDMA. In all cases, the student should be able to dimension, design, and evaluate systems at the physical layer level.
Select the most appropriate protection measures, at the radio engineering and system levels, to achieve the highest quality in a radio transmission system: coding, interleaving, channel equalization, retransmission techniques, etc

STUDY LOAD

Type	Hours	Percentage
Self study	70,0	56.00
Hours large group	55,0	44.00

Total learning time: 125 h

CONTENTS

Introduction to communication systems.

Description:
This block aims to introduce students to the concepts of the course through an overview of telecommunication systems and their relationship with other subjects. The topic defines the basic building blocks of a communication system that must be considered in any design. A global perspective of a communication system is provided, including all its elements (information sources, source coding, channel coding, modulation, multiplexing, multiple access, transmission, reception, demodulation, equalization, synchronization, etc.). Quality parameter concepts are also introduced: signal-to-noise ratio, probability of error, transmission rate, delay, throughput, etc.

Full-or-part-time: 3h
Theory classes: 2h
Self study : 1h

Communication channel: noise and signals

Description:
This block aims to introduce students to the concepts of noise and signals in communications. Concepts of frequency translation, signal and system bandwidth, bandpass signals: phase and quadrature. Noise sources. Types and characterization. Noise factor and temperature.

Full-or-part-time: 7h
Theory classes: 3h
Self study : 4h

Analog communications

Description:
This block will focus on the analysis of analog amplitude and frequency modulations, emphasizing basic aspects such as bandwidth, power, recovery of the information signal, frequency and phase synchronization, and signal-to-noise ratio.

Full-or-part-time: 8h
Theory classes: 4h
Self study : 4h

Digital communications

Description:
In this block, students will be introduced to the fundamental concepts of digital signal transmission. Baseband digital transmissions. Signal spectrum. Signal detection in AWGN channels. Receiver scheme. Matched filter. Probability of error. Transmission over band-limited channels. Bandpass digital transmissions. Digital modulations. Signal model.

Full-or-part-time: 30h
Theory classes: 14h
Self study : 16h

Channel coding

Description:
Introduction. ARQ vs. FEC. Classification of FEC codes and notation used. Block codes. Convolutional codes. For each type of code, a description will be provided. Some examples of codes in use will be presented. The complexity will be described, and the code performance will be presented. Interleaving.

Full-or-part-time: 18h
Theory classes: 7h
Self study : 11h

Channel equalization

Description:
This block explains in detail the technique of channel equalization to compensate for the effects of distortion and ISI that occur in broadband transmissions, which appear more frequently as transmission rate requirements increase. The different types of channel equalizers are described.

Full-or-part-time: 21h
Theory classes: 9h
Self study : 12h

Multiple Access Techniques

Description:
This block studies and analyzes multiple access techniques (FDMA, TDMA, CDMA, SDMA) applicable to wireless transmission systems. Special emphasis is placed on spread-spectrum signal transmission techniques (FH-CDMA and DS-CDMA). The entire transmission and reception chain of these systems will be studied, including the generation and characteristics of spreading codes, as well as the design, sizing, and evaluation of a CDMA-based transmission system.

Full-or-part-time: 19h
Theory classes: 8h
Self study : 11h

Multicarrier transmission techniques: OFDM

Description:
This block provides an in-depth study of multicarrier transmission techniques, focusing on the OFDM transmission technique

Full-or-part-time: 19h
Theory classes: 8h
Self study : 11h

GRADING SYSTEM

The evaluation criteria defined on the course infoweb will be applied.

BIBLIOGRAPHY

Basic:
- Faúndez Zanuy, Marcos. Sistemas de comunicaciones.. ISBN 8426713041.
- A.Bruce Carlson. Sistemas de comunicación. ISBN 9701061055.

RESOURCES

Computer material:
- WinIQSim. Resource