Course guide
300037 - CSF - Wireless Communications

Last modified: 11/05/2026

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 NETWORK ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

Operability with complex numbers, arrays, variables and random processes.
Analysis of signals and systems, both analogue and digital, in the time and frequency domains.
Both linear and logarithmic (dB) scales.
Basic knowledge of communications, antennas, transmitters and receivers

REQUIREMENTS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE 21 SIS. Capacidad para construir, explotar y gestionar las redes, servicios, procesos y aplicaciones de telecomunicaciones, entendidas éstas como sistemas de captación, transporte, representación, procesado, almacenamiento, gestión y presentación de información multimedia, desde el punto de vista de los sistemas de transmisión.(CIN/352/2009, BOE 20.2.2009.)

Transversal:
2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
5. 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.
6. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

Thanks to the material prepared by the professors of the subject: slides, class notes, solved exercises, etc., available on the ATENEA digital campus, the student has sufficient tools to work independently, either in a group or individually, and in this way you will be able to take advantage of the face-to-face class to consolidate concepts and resolve any doubts that may have arisen.
In the theory sessions (groups of a maximum of 40 students) based on expository classes, the professors' formal explanation is combined with informal questions to the students, which favor the understanding and establishment of the basic concepts of the subject. This more active participation on the part of the student is possible thanks to the subject material available, since students do not have to be in class simply taking notes.
The professor will jointly solve some of the proposed exercises and may propose exercises to be solved by the students during independent learning hours.
Signal analysis activities will be proposed that students will have to work in groups and present the corresponding reports.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Wireless Communications subject, the student must be able to:
· Know the main standards of wireless communications systems and their present and future applications.
· Know the main characteristics of radio communications regulations for different radio communications systems (broadcasting, mobile communications, terrestrial links, satellite, positioning signals, etc.).
· Know and understand advanced digital signal modulation mechanisms particularly suitable for wireless environments, while being able to analyze and design systems based on these mechanisms.
· Know and understand multi-carrier transmission techniques, especially OFDM, their technical features, parameters, their advantages, limitations and their implementation complexities. They will need to know how to dimension a radio link based on these techniques, as well as properly configure its operating parameters and evaluate its performance.
· Know and understand the main spread spectrum transmission techniques, especially those based on CDMA. In all cases, they will need to be able to dimension, design and evaluate systems at the physical layer level.
· Choose the most appropriate protection measures, at the level of radio link and system, to achieve the highest quality of a radio transmission system: coding, interleaving, channel equalization, retransmission techniques, etc.

STUDY LOAD

Type	Hours	Percentage
Hours large group	66,0	44.00
Self study	84,0	56.00

Total learning time: 150 h

CONTENTS

Introduction and Regulation

Description:
Fundamental concepts of wireless communications, scopes and applications, standards, classification of systems, trends and forecasts, innovative concepts and techniques. Basic description of advanced techniques such as cooperative communications, Network Coding, Space Modulations, Massive MIMO and VLC. Basic description of the main features of 5G technology.
Regulation of radio communications, basic concepts of regulation, regulatory bodies, legislation and recommendations, market regulation, universal service.

Related activities:
Activity 1

Full-or-part-time: 18h
Theory classes: 14h
Self study : 4h

Signal Modulations for Wireless Communications

Description:
In this block the most appropriate digital modulations for wireless transmission systems are studied and analyzed, completing the study carried out in other subjects by introducing the concept of constant envelope modulations and differential coding. A review of all the fundamental concepts of signal theory and communications is made. Emphasis is placed on concepts especially relevant for radio communications such as the construction of the baseband signal, decomposition into in-phase and quadrature components, band pass signals, constellations, PAPR, ACP, relationship between SNR, BER and spectral efficiency, etc.

Related activities:
Activity 2

Activity 3

Full-or-part-time: 35h
Theory classes: 20h
Self study : 15h

Multiple Access Techniques, spread spectrum, CDMA

Description:
In this block, multiple access techniques (FDMA, TDMA, CDMA, SDMA, OFDMA) applicable to wireless transmission systems are studied and analyzed. Special emphasis is placed on spread spectrum signal transmission techniques (FH-CDMA and DS-CDMA). The entire transmission and reception chain of this type of systems will be studied, as well as the generation and characteristics of the spreading codes, the design, dimensioning and evaluation of a CDMA-based transmission system.

Related activities:
Exercice resolution

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

Channel Equalisation

Description:
This block explains channel equalization techniques to compensate for distortion and ISI effects that are generated in broadband transmissions, which appear more frequently when the need for transmission rates increases and when spread spectrum techniques are used. The different types of channel equalizers are described, the LMS algorithm and the design, calculation of coefficients and performance analysis of some types of equalizers are carried out.

Related activities:
Activity 5
Exercice resolution

Full-or-part-time: 24h
Theory classes: 12h
Self study : 12h

Multicarrier transmissions, OFDM

Description:
In this section, multicarrier transmission techniques are studied, focusing on the OFDM transmission technique, as well as DMT modulation. All the theoretical details and the implementation characteristics in real systems will be described. Dynamic adaptation mechanisms and a bitloading algorithm called water filling are included.
This technique is presented as a high-efficiency alternative to channel equalizers in order to be able to use broadband signals without suffering the distortion and ISI effects due to the limitations of the channel's coherence bandwidth.

Related activities:
Activity 4
Exercice resolution

Full-or-part-time: 35h
Theory classes: 20h
Self study : 15h

Radio Engineering Techniques

Description:
In this block, some of the most used techniques in wireless communication systems to combat the harmful effects of the radio channel are studied and analyzed, such as channel coding, hybrid retransmission techniques (HARQ), soft combining, incremental redundancy and interleaving schemes.

Related activities:
Exercise resolution

Full-or-part-time: 13h
Theory classes: 5h
Self study : 8h

ACTIVITIES

COVERAGE AND REGULATION STUDY OF A WIRELESS COMMUNICATIONS SYSTEM

Description:
COVERAGE AND REGULATION STUDY OF A WIRELESS COMMUNICATIONS SYSTEM

Full-or-part-time: 4h
Guided activities: 4h

Study of digital radiocommunications signals: analysis of the PAPR of the signal.

Description:
Study of digital radiocommunications signals: analysis of the PAPR of the signal.

Full-or-part-time: 5h
Guided activities: 5h

Study of digital signals: analysis of the signal ACP

Description:
Study of digital signals: analysis of the signal ACP

Full-or-part-time: 5h
Guided activities: 5h

Study of the effects of multipath propagation in radio frequency signals.

Description:
Study of the effects of multipath propagation in radio frequency signals.

Full-or-part-time: 5h
Guided activities: 5h

Channel equalisers test

Description:
The student will have to carry out a test where he/she will be asked to demonstrate the knowledge that he/she should have acquired in the theory classes and problems prior to the test.

Delivery:
It has 15% weight in the final mark

Full-or-part-time: 2h
Guided activities: 2h

GRADING SYSTEM

Exams: 50%. Mid-term and final
Test: 15%
Practical activities and reports done in teamwork: 30%
Attitude and participation: 5%

EXAMINATION RULES.

The completion and delivery of reports is mandatory in order to pass the course.

BIBLIOGRAPHY

Basic:
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- Molisch, Andreas F. Wireless communications : from fundamentals to beyond 5G. Third edition. Hoboken, New Jersey: Wiley IEEE Press, 2023. ISBN 9781119117209.