



PRESENTACIÓN

Brief description the course: The course describes the problems that present mobile and wireless communication systems, with particular emphasis on the effects of the channel, such as fading and Doppler spread. Tools to counteract these effects that are usually employed in the design of digital demodulators are shown in this course. Different digital modulation techniques, such as multicarrier modulation or spread spectrum, are studied and implemented.

- **Titulación:** Master in Telecommunications Engineering
- **Módulo/Materia:** Tecnología de Telecomunicación / Teoría de la señal y la comunicación
- **ECTS:** 5
- **Curso, semestre:** Second semester, third bimester
- **Carácter:** Obligatorio
- **Profesorado:**
 - Vélez Isasmendi, Igone / Profesor colaborador (ivelez@ceit.es)
 - Zamora Cadenas, Leticia / Profesor colaborador (lzamora@ceit.es)
 - Rezola Garcíandia, Ainhoa / Profesor contratado doctor (argarciandia@tecnun.es)
- **Idioma:** Inglés (5 ECTS)

COMPETENCIAS

- CB7 - Students will know how to apply the knowledge acquired and will have the ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
- CB10 - Students will possess sufficient learning abilities to continue studying, to a considerable extent, autonomously and under their own guidance.
- CG1 - Students will be able to plan, calculate and design products, processes and facilities in every area of telecommunications engineering.
- CG8 - Students will acquire the knowledge, understanding and ability to apply necessary legislation in the exercise of a Telecommunications Engineering career.
- CE01 - Students will have the ability to apply methods of information theory, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing for communication and audiovisual systems.
- CE03 - Students will have the ability to implement cable, wire and satellite systems in fixed and mobile communications environments.

CONTENTS OF THE COURSE

1. Introduction to wireless communications

- Introduction to mobile and wireless systems.

2. Implementation of digital communication systems in AWGN channels



Universidad
de Navarra

- Reviewing a QAM communication system.
- Synchronization techniques.
- Analog impairments introduced by the front-end in a transceiver.

3. Implementation of digital communication systems in fading channels

- Fading channels and how to model them.
- Implementing digital communication systems in fading channels.
- Multicarrier modulation and OFDM.
 - Example of an OFDM system: IEEE802.11 standard.
- Spread spectrum techniques.
 - Example of a spread spectrum system: IEEE802.11 standard.

EDUCATIONAL ACTIVITIES

The theoretical part is accompanied by a series of lab sessions that illustrate the most important aspects of the course.

Theory sessions

Students must attend the lectures as they are the basis to perform the practice sessions of the Questionnaires will be employed to evaluate the knowledge acquired by the students in these t be evaluated positively in the final grade.

Lab sessions

In the computer lab, the Matlab sessions will be explained. The practice sessions must be done individually. It is expected that the student works during the lab session and and outside code of the work done in the lab sessions. It will be necessary to attend all practice sessions to be evaluated positively grade.

Project

Each student will implement in Matlab a baseband processor of a telecommunications system.

EVALUACIÓN

ORDINARY ASSESSMENT

Questionnaires: 2 point. Students must deliver all questionnaires.

Test about the labs: 2.5 points. Students must attend to all lab sessions. The work done in the practice sessions will be evaluated by means of a questionnaire.

Final Project: 3 points. The work done in the project will be assessed, together with the report.

Exam: 2.5 points. The students will be asked questions about the final project.

Criteria to pass the course in ordinary call:

- Students whose final grade is 5 points or more will pass the course.



Universidad de Navarra

- Students whose final grade is below 5 points will not pass the course and will be graded as *Suspense*.
- Students who do not take all questionnaires, tests and the exam will not pass the course and will be graded as *No presentado*.

Exams review

Students will be able to review the exams in an interview with the professor, after publication of the grades, in a day and place that will be indicated.

EXTRAORDINARY ASSESSMENT

For those students that have delivered all labs and the final project on time, the resit will consist of an exam with questions about the theory of the subject and about the work done by the students in the labs and final project. If a student has not delivered some labs or the project throughout the subject, he/she shall deliver them before the date of the resit exam so that the mark of the resit is taken into account.

No marks will be saved for the next academic year. That is, if a student does not pass on this ca he/she will go to the next year with the complete subject.

HORARIOS DE ATENCIÓN

Contact the corresponding teacher by email to arrange an appointment.

BIBLIOGRAFÍA

Main references:

- A. Goldsmith. "Wireless Communications", Cambridge University Press, 2005 [Localízalo en la biblioteca](#) [Localízalo en la biblioteca \(formato electrónico\)](#)
- H. Meyr, M. Moeneclaey, S. A. Fechtel, "Digital Communication Receivers: Synchronization, Channel Estimation and Signal Processing", John Wiley & Sons, 1997. [Localízalo en la biblioteca](#)
- J.G. Proakis. "Digital Communications". McGraw-Hill. 4ª edición. 1995. [Localízalo en la Biblioteca](#)

Other references:

- A. R. S. Bahai, B. R. Saltzberg, "Multicarrier Digital Communications. Theory and Applications of OFDM", Kluwer Academic/ Plenum Publishers, 1999.
- U. Mengali, A. N. D'Andrea, "Synchronization Techniques for Digital Receivers", Plenum Press, 1997. [Localízalo en la biblioteca](#)
- M. C. Jeruchim, P. Balaban, K. S. Shanmugan, "Simulation of Communication Systems. Modeling, Methodology and Techniques", Kluwer Academic/ Plenum Publishers, 2000. [Localízalo en la biblioteca](#)
- D. Tse, P. Wiswanath, "Fundamentals of Wireless Communications" Cambridge University Press, 2005.
- B. Sklar. "Digital Communications". Prentice-Hall. 1998. [Localízalo en la biblioteca \(formato papel y electrónico\)](#)
- T.S. Rappaport. "Wireless communications. Principles and practice". Prentice Hall. 1996 [Localízalo en la biblioteca](#)



Universidad
de Navarra

- S. Haykin. "Communication systems". John Wiley & Sons. 4ª edición. 2001
[Localízalo en la biblioteca](#)