



## 20015 - COMMUNICATION THEORY (2018-19)

### General

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**Code:** 20015

**Lecturer responsible:**

LOPEZ SANCHEZ, JUAN MANUEL

<b>Credits ECTS:</b>	<b>6</b>
Theoretical credits:	1,2
Practical credits:	1,2
Distance-base hours:	3,6

### Departments involved

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- **Dept:** PHYSICS, ENGINEERING SYSTEMS AND SIGNAL THEORY  
**Area:** SIGNAL THEORY AND COMMUNICATIONS  
**Theoretical credits:** 1,2  
**Practical credits:** 1,2  
This Dept. is responsible for the course.  
This Dept. is responsible for the final mark record.

### Study programmes where this course is taught

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- DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING  
Course type: COMPULSORY (Year: 2)

## Competencies and objectives

### Course context for academic year 2018-19

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This core subject provides tools to design communications systems from the point of view of transmission of information. Different ways to implement these systems and to send information in signal form are described, based on analog and digital modulations.

Capabilities and limitations of different modulation types are studied, together with the effects of both channel and system itself upon the final quality of the communication. This leads to design tradeoffs which are common in engineering, regarding requirements about power, bandwidth, bit rate, etc.

It is recommended to study this subject after passing the following ones:

20009 - Mathematics I

20013 - Mathematics II

20014 - Signals and systems

It is recommended to study this subject simultaneously to:

20019 - Digital signal processing

## Course content (verified by ANECA in official undergraduate and Master's degrees)

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### UA Basic Transversal Competences

- **CT10** : Capacity to confront, plan and solve real problems demanded by society in the field of engineering.
- **CT11** : Capacity to learn and apply new concepts and methods in an autonomous and interdisciplinary fashion.
- **CT12** : Capacity to assimilate and adapt to the permanent evolution of technology when developing one's professional career.
- **CT13** : Capacity to adopt the scientific method when planning and carrying out different academic and professional tasks.

### Specific Competences:>>Basic

- **B2** : Basic understanding of using and programming computers, operating systems, databases and computer programs for use in engineering.

### Basic Transversal Competences

- **CT1** : Students should show they possess and understand knowledge in a field of study that continues from general secondary education and is usually found at a level which, although supported by advanced textbooks, also includes certain aspects that involve knowledge arising from the cutting edge of their field of study.
- **CT2** : Students should know how to apply their knowledge to their job or vocation in a professional manner and should possess those skills that are usually reflected when preparing and defending arguments and solving problems in their field of study.
- **CT3** : Students should have the ability to gather and interpret relevant data (normally within their field of study) to give opinions that include a reflection on important, social, scientific, ethical matters, etc.
- **CT4** : Students should be able to transmit information, ideas, problems and solutions to both specialist and non-specialist audiences.
- **CT5** : Students should have developed the necessary learning skills to take on later studies with a high level of autonomy.

### Specific Competences: >> Competences Common to the Telecommunications Branch

- **C4** : Capacity to analyse and specify the fundamental parameters of communication systems.
- **C5** : Capacity to assess the advantages and drawbacks of different technological alternatives for the deployment and implementation of communications systems, from the point of view of signal space, perturbations and noise and analogue and digital modulation systems.

## Exclusive skill taught in this course

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No data

## Learning outcomes (Training objectives)

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No data

## Specific objectives stated by the academic staff for academic year 2018-19

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- To understand the core problem of communicating and the necessity of coding and modulating the information.
- To understand the basic scheme and the functional blocks which are used in communication systems.
- To understand, analyze and apply analog and digital modulations.
- To understand, analyze and apply all main concepts related to digital transmission of signals.
- To understand and analyze the unwanted effects present in communication systems: noise, distortion, interferences.

# Content and bibliography

## Content for academic year 2018-19

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### Unit 1. Introduction to Communication Systems

- 1.1. Motivation
- 1.2. Block diagram of a communication system
- 1.3. Analog and digital communications
- 1.4. Basic concepts
- 1.5. Design tradeoffs

Competences: C-1, C-4, C-5, CT-1, CT-2, CT-3, CT-4, CT-5, CT-10, CT-11, CT-12, CT-13

### Unit 2. Random Signals and Noise

- 2.1. Introduction
- 2.2. Random variables
- 2.3. Random or stochastic processes
- 2.4. Stationary processes
- 2.5. Correlation and power spectral density
- 2.6. Noise
- 2.7. Distortion
- 2.8. Interference

Competences: B-2, C-1, C-4, C-5, CT-1, CT-2, CT-3, CT-4, CT-5, CT-10, CT-11, CT-12, CT-13

### Unit 3. Analog Modulations

- 3.1. Introduction
- 3.2. Linear modulations
  - 3.2.1. Types: DSB, AM, SSB, VSB, QAM
  - 3.2.2. Noise in linear modulations
- 3.3. Angular modulations
  - 3.3.1. Modulation in frequency and phase
  - 3.3.2. Noise in angular modulations

Competences: B-2, C-1, C-4, C-5, CT-1, CT-2, CT-3, CT-4, CT-5, CT-10, CT-11, CT-12, CT-13

### Unit 4. Baseband Digital Transmission

- 4.1. Introduction
- 4.2. Model of digital communication system
- 4.3. Source coding
  - 4.3.1. Information theory. Entropy
  - 4.3.2. Variable-length coding
- 4.4. Pulse-code modulation (PCM)
- 4.5. Baseband transmission
- 4.6. Detection
- 4.7. Inter-symbol interference
- 4.8. Partial response signaling

Competences: B-2, C-1, C-4, C-5, CT-1, CT-2, CT-3, CT-4, CT-5, CT-10, CT-11, CT-12, CT-13

#### Unit 5. Bandpass Digital Transmission

5.1. Introduction

5.2. Basic modulation techniques

5.3. Detection

5.4. Advanced modulations

5.5. Evaluation and comparison

Competences: B-2, C-1, C-4, C-5, CT-1, CT-2, CT-3, CT-4, CT-5, CT-10, CT-11, CT-12, CT-13

#### Unit 6. Design of Digital Communication Systems

6.1. Error probability plane

6.2. Shannon Theorem

6.3. Bandwidth efficiency plane

6.4. Multiplex and multiple access

Competences: B-2, C-1, C-4, C-5, CT-1, CT-2, CT-3, CT-4, CT-5, CT-10, CT-11, CT-12, CT-13

## Assessment

### Assessment procedures and criteria 2018-19

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#### 1. ORDINARY CALL (C3, JUNE)

Mark = Final Exam (50%) + Problems Exams (20%) + Theory Tests (10%) + Computer-based Laboratory Sheets (20%)

Remarks:

- The marks of the activities carried out during the term can not be upgraded in this call.
- The mark of the Final Exam must be equal or greater than 4 over 10.

#### 2. EXTRAORDINARY CALLS (C1 AND C4, DECEMBER AND JULY)

Mark = Final Exam (50%) + Problems Exams (20%) + Theory Tests (10%) + Computer-based Laboratory Sheets (20%)

Remarks:

- All the marks of Theory Tests, Problem Exams and Computer-based Laboratory Sheets are maintained when the final mark is better than the mark of the Final Exam alone. Otherwise, the mark of the Final Exam will be the only one to be considered, and it includes the upgrade of all marks of the activities carried out during the course.
- The mark of the Final Exam must be equal or greater than 4 over 10.

- Upgradable activities: Final Exam (50%).

Description	Criteria	Type	Weighting system
COMPUTER-BASED LABORATORY	Delivery of a sheet with all results of the laboratory experience at the end of each session	ACTIVITIES OF EVALUATION DURING THE SEMESTER	20
PROBLEM SOLVING	Exam of problems (4 in total). Weeks 4, 8, 11 and 14.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	20
THEORY	Multiple selection tests to be fulfilled at the Virtual Campus out of the lessons time (4 in total).  Weeks: 5 (U1-U2), 9 (U3), 12 (U4) and 15 (U5-U6).	ACTIVITIES OF EVALUATION DURING THE SEMESTER	10
FINAL EXAM	Final exam consisting of 3-4 problems and/or practical cases.	FINAL TEST	50

## Official exam dates for academic year 2018-19

Exam session	Date	Time	Group - Classroom(s) allocated	Comments
(C3) Periodo ordinario para asignaturas de segundo semestre y anuales	04/06/2019			Teoría
(C4) Pruebas extraordinarias para asignaturas de grado y máster	11/07/2019			Teoría

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