

Academic Year: ( 2023 / 2024 )

Review date: 12-05-2023

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: LAZARO TEJA, MARCELINO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Linear Systems (Second year, first semester)

Communication Theory (Second year, second semester)

**OBJECTIVES**

Knowledge and management of the different techniques of digital communications (linear and non-linear, multi-carrier and spread spectrum), the structure of receivers and the basic techniques for protection against errors in digital communications.

Therefore, the subject has the goal of allowing the student to acquire the following general competences:

- Knowledge and development of technical skills required in the telecommunications field with emphasis in the analysis and mathematical characterization of a digital communication system.

In particular, the following specific competences:

- Acquisition of the knowledge of mathematics and statistics that will be used as a tool to solve engineering problems in the context of digital communication systems.
- The ability to design and conduct experiments, as well as to analyze and interpret data and results.
- Design of a communication system with realistic constraints given by critical parameters such as cost, consume of power, bandwidth, transmission rate, and complexity.
- Ability of effective communication of information, in speech and in writing.

**DESCRIPTION OF CONTENTS: PROGRAMME****1.- Introduction**

- 1.1.- Introduction to digital communication systems
- 1.2.- Digital communication model
- 1.3.- Objectives and organization of the course

**2.- Linear modulations**

- 2.1.- Baseband PAM modulations
- 2.2.- Bandpass PAM modulations

**3.- Detection under intersymbol interference**

- 3.1.- Problem statement
- 3.2.- Memoryless symbol-by-symbol detector
- 3.3.- Maximum likelihood sequence detector
- 3.4.- Channel equalizers

**4.- Non-linear modulations (phase and frequency modulations)**

- 3.1.- QPSK and OQPSK modulations
- 3.2.- Differential phase modulations (DPSK)
- 3.3.- Frequency modulations (CPFSK and MSK)
- 3.4.- Continuous phase modulations (CPM)

**4.- Multipulse modulations**

- 4.1.- Spread spectrum modulations (DS-SS, FH-SS)
- 4.2.- Frequency division multiplex modulations (FDM, OFDM)

## 5.- Channel coding for error protection

5.1.- Introduction to channel coding and some definitions a la codificación y definiciones

5.2.- Linear block codes

5.3.- Convolutional codes

## LEARNING ACTIVITIES AND METHODOLOGY

Three teaching activities are proposed: Theoretical classes, exercise classes and laboratory exercises.

The ECTS credits include in all cases the personal work and group work to be carried out by the student.

### THEORETICAL CLASS AND EXAMPLES (3 ECTS)

The theoretical class will be given in the blackboard, with slides or by any other means to illustrate the concepts learnt. In these classes the explanation will be completed with examples. In these sessions the student will acquire the basic concepts of the course. It is important to highlight that these classes require the initiative and the personal and group involvement of the students (there will be concepts that the student himself should develop).

### CLASS EXERCISES (1 ECTS)

Before the exercise class, the student will have available the exercise list. The student should solve the exercises proposed in order to assimilate the concepts obtained in the theoretical class in a more complex environment and to self-evaluate his knowledge.

### LABORATORY EXERCISES (2 ECTS)

Basic concepts learnt during the course are applied by means of simulation. The student should participate actively on the exercise implementation; the level of the student involvement in this work grows from the first exercise to the last one where the student will be encouraged to propose and solve the problem.

## ASSESSMENT SYSTEM

The final exam will determine 60% of the total course grade (6 points).

The rest of the grading 40% (4 points) is obtained along the academic year as follows:

1. At the end of some course chapters there will be one partial exam with one or several exercises that will be solved in class.
2. Laboratory exercises. There laboratory exercises are MANDATORY.

The detailed rules and weights for the grading of each part will be provided at the beginning of the course.

It is necessary to obtain a minimum grade of 4 of 10 points in the final exam.

<b>% end-of-term-examination:</b>	60
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40

## BASIC BIBLIOGRAPHY

- A. Artés, F. Pérez, J. Cid, R. López, C. Mosquera, F. Pérez. Comunicaciones Digitales, Pearson Educación, 2007
- B. Sklar Digital Communications, Prentice Hall, 1988
- J.G. Proakis Digital Communications, McGraw-Hill, 2001