# Communication Theory

**Academic Year: ( 2019 / 2020 )** **Review date: 14-05-2020**

**Department assigned to the subject: Department of Signal and Communications Theory**

**Coordinating teacher: LAZARO TEJA, MARCELINO**

**Type: Compulsory ECTS Credits : 6.0**

**Year : 2 Semester : 2**

## STUDENTS ARE EXPECTED TO HAVE COMPLETED

Statistics (First year, second semester)
Systems and Circuits (First year, second semester)
Linear Systems (Second year, first semester)

## COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

Knowledge and management of the basic concepts and techniques for digital and analog communication such as noise, modulation and demodulation processes in digital communications, the information theory as a tool to establish the limits in communication systems and the fundamental techniques for analog 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 communication system.

The same way than 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 communication systems. (PO a, PO e, and PO k)
- The ability to design and conduct experiments, as well as to analyze and interpret data and results. (PO b)
- Design of a communication system with the constraints given by its critical parameters such as cost, consume of power, bandwidth, transmission rate, and complexity. (PO c)
- Ability of effective communication of information, in speech and in writing. (PO g)

## DESCRIPTION OF CONTENTS: PROGRAMME

1.- Introduction
  1.1.- Definition of a communication system
  1.2.- Functional elements of a communication system
  1.3.- Digital and analog communication systems
  1.4.- Design of a communication systems
  1.5.- Objectives and organization of the course

2.- Noise in communication systems
  2.1.- Review: probability, random variables, and random processes
  2.2.- Random processes in the frequency domain
  2.3.- Statistical model for thermal noise

3.- Analog modulations
  3.1.- Introduction to the modulation concept
  3.2.- Amplitude modulations
  3.3.- Angle modulations
  3.4.- Effect of noise in analog modulations

4.- Modulation and detection in gaussian channels
  4.1.- Introduction to digital communication systems
  4.2.- Geommetric representation of signals
  4.3.- Digital communication model
    - Encoder
    - Modulator

- Demodulator
- Detector

5.- Basic limits
5.1.- Probabilistic models for information sources
5.2.- Probabilistic models for channels
5.3.- Quantitative information measurements
5.4.- Channel capacity

## LEARNING ACTIVITIES AND METHODOLOGY

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

THEORETICAL CLASS AND EXAMPLES (3.5 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 (1.5 ECTS)
Before the exercise class, the student will have available the exercise formulation. 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.
In the exercise class one student will have to present the exercise proposed solving and the rest of students should give feedback on this particular problem solving. This will encourage the opinion exchange between students and the professor and among students

LABORATORY EXERCISES (1 ECTS)
Basic concepts learnt during the course are applied in the laboratory and by means of simulation. The student should participate actively 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

Grade for continuous assessment will determine the 40% of the total grade (4 points).
This part of the grade is obtained along the academic year as follows:

1. At the end of the basic course chapters, students will have to solve one or several practical exercises. (PO a, PO c, PO e, PO g, and PO k)
2. Some of the exercises proposed in class will be solved by the students (PO a, PO c, PO e, PO g, and PO k)
3. Laboratory exercises. These laboratory exercises are MANDATORY. (PO b y PO k)

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

The final exam will determine 60% of the total course grade (6 points). (PO a, PO c, PO e, PO g, and PO k)
It is necessary to obtain a minimun grade of 4 of 10 points in the final exam.

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| **% end-of-term-examination:** | 60 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 40 |

## BASIC BIBLIOGRAPHY


- Amos Lapidoth A Foundation in Digital Communication, Cambridge University Press, 2009
- J. G. Proakis, M. Salehi. Communication Systems Engineering, 2nd edición, Prentice-Hall, 2002
- S. Haykin Communication Systems, 4th Edition, Wiley, 2001


## ADDITIONAL BIBLIOGRAPHY


- A. Artés, F. Pérez, J. Cid, R. López, C. Mosquera, F. Pérez Comunicaciones Digitales, Pearson Educación, 2007
- Carlson, A.B. New York, , 1986. Communication Systems, McGraw-Hill, 1986
- J. Proakis Digital Communications, 3rd, McGraw-Hill, 1995
- T. M. Cover and J.A. Thomas Elements of Information Theory, Wiley, 2006