Communication Theory

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

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: LAZARO TEJA, MARCELINO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Statistics (First year, second semester)
Systems and Circuits (First year, second semester)

Students are also expected either to have completed or to be simultaneously enrolled at Linear Systems (Second year, first semester)

OBJECTIVES

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

The final exam will determine 60% of the total course grade (6 points). (PO a, PO c, PO e, PO g, and PO k)
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 a partial exam where one or several practical exercises have to be solved in class. (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)

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 minimun grade of 4 of 10 points in the final exam.

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

BASIC BIBLIOGRAPHY

- J.G. Proakis, M. Salehi Communications System Engineering, Second Edition, NJ, Prentice-Hall, Englewood Cliff, NJ, 2002

ADDITIONAL BIBLIOGRAPHY

- Carlson, A.B. Communication System, McGraw-Hill, New York, 1986
- Hambley A.R. An Introduction to Communication Systems, Computer Science Press, 1990