Universidad Carlos III de Madrid

Telecommunications and Signal Processing

Academic Year: (2019 / 2020)   Review date: 17-05-2019

Department assigned to the subject:

Coordinating teacher: SANCHEZ FERNANDEZ, MATILDE PILAR

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

This is an introductory course to signal processing and communications for space environments. For this reason, the only recommendation established is the one needed for access to the Master.

OBJECTIVES

Knowledge and management of the basic concepts and techniques for space communication and signal processing: modulation techniques, multiplexing, coding and link budget analysis.

Therefore, the subject has the goal of allowing the student to acquire the following general competences:
- To possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context (CB6)
- Students must know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study (CB7)
- Students must be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments (CB8)
- Students must know how to communicate their conclusions and the knowledge and ultimate reasons that sustain them to specialized and non-specialized audiences in a clear and unambiguous way (CB9)
- Students must have the learning skills allowing them to continue studying in a way that will be largely self-directed or autonomous. (CB10)
- Capacity for the formulation, critical verification and defense of hypotheses, as well as the design of experimental tests for verification. (CG1)
- Ability to make value judgments and prioritize in making conflicting decisions using systemic thinking. (CG2)
- Ability to work in multidisciplinary teams in a cooperative way to complete work tasks (CG4)
- Ability to handle the English, technical and colloquial language. (CG5)

The same way than the following specific competences:

- Ability to understand and apply the knowledge, methods and tools of space engineering to the analysis and design of the communication subsystem of space vehicles. (CE11)

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to space communications
1.1. Chanel propagation characterization

2. Modulation and multiplexing techniques for space links
2.1 Phase modulation and differential modulations
2.2 Design of the receiver

3. Multiple access and advanced signal processing techniques
3.1 MIMO technology for space
3.2 Multiple access

4. Encoding and error correction techniques
4.1 Linear enconding
4.2 Convolutional encoding
4.3 Novel encoding techniques

5. Overall Link performance

LEARNING ACTIVITIES AND METHODOLOGY

Two teaching activities are proposed: Theoretical classes, practical sessions.

THEORETICAL CLASS AND EXAMPLES (2 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).

PRACTICAL SESSIONS (1 ECTS)

The practical classes will solve practical cases as well as laboratory sessions in which specific systems will be simulated.

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 70% of the total grade (7 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. 7
2. Laboratory exercises. These laboratory exercises are MANDATORY.

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 30% of the total course grade (3 points).

% end-of-term-examination:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

BASIC BIBLIOGRAPHY

 - Gerard Maral, Michel Bousquet, Zhili Sun Satellite Communications Systems: Systems, Techniques and Technology, Wiley Series in Communication and Distributed Systems, 2009