Electromagnetic Fields

Academic Year: (2019 / 2020) **Review date: 18/05/2020 21:29:23**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: INCLAN SANCHEZ, LUIS FERNANDO DE

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Calculus I
- Calculus II
- Linear Algebra
- Physics

OBJECTIVES

The aim of this course is to establish and analyze the basic concepts that constitute the core of the model of electromagnetic radiation and propagation, both in a free and a confined medium and to introduce the most commonly used numerical procedures to be applied to the model being studied.

In order to achieve this goal, the student will obtain a knowledge based on a set of skills. In terms of knowledge, the student will learn:

- The electromagnetic wave propagation basics and their essential parameters.
- The Maxwell model including the specific boundary conditions.
- The importance of the materials in the wave propagation study.
- The plane wave set of solutions as an approximation to different real problems: its characteristics, the effect of material discontinuities, the polarization, etc.
- The fundamentals of wave propagation along a guiding structure: waveguides and transmission lines. In addition, the student will obtain the knowledge to analyze these structures.
- The fundamentals of the radiation of electromagnetic waves. This includes different concepts related to the antennas and the parameters which describe them.
- The roll of the different elements comprising a communication radio link.

In terms of the specific skills, during the course the student will achieve:

- The understanding of the different parameters that characterize the electromagnetic free and guided propagation.
- The interpretation of the polarization of a plane wave.
- The classification of the materials as a function of their electromagnetic characteristics.
- The problem of the incidence of electromagnetic waves in incidence problems (changes in materials, including the reflection over perfect electric conductors). Interpretation of reflection, refraction an transmission phenomena.
- The analysis of the wave propagation inside waveguides and transmission lines: modes, cutoff frequency, evanescence, attenuation, etc. Design of waveguides fulfilling certain specifications, with particular emphasis on rectangular waveguides and some simple homogeneous transmission lines.
- The understanding of the parameters that define the antennas.

In terms of the generic skills, during the course the student will achieve:

- An overview of telecommunication systems by analyzing and understanding the essential role of the propagation of electromagnetic waves. The student will achieve the ability to apply knowledge of mathematics and physics to the analysis and design of telecommunication systems from an engineering point of view. Many examples of real systems will be presented to related all the presented

contents with the contents studied in other courses (PO a y c).

- In addition he/she will be able to use technical computing software packages such as MATLAB as a tool to solve many of the problems found during the course (PO b y k).

- Ability to work in group and effectively communicate the results of the realized experiments (PO b, k).

- Assumption by the student of the necessity continuous learning and knowledge in a step by step process (PO a, c y e).

DESCRIPTION OF CONTENTS: PROGRAMME

The programme is divided in four parts:

1. The electromagnetic model
2. Electromagnetic propagation in a free medium
3. Propagation in confined media
4. Electromagnetic radiation

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will consist of three parts:

a) Lectures on the main theoretical topics: the main theoretical topics of the course will be presented in these classes. Both the blackboard and computer presentations will be used. The students can have a text book and a set of slides covering all the topics in the course. This set of slides will be available from the beginning of the course. (PO a y c).

b) Lectures on practical exercises. The students group will be divided in smaller groups with less than forty students. The students can have a problems book with many problems covering the topics of the course. (PO c y e).

c) Practical work in the laboratory. The students will be divided in groups of 20 students to realize the four proposed practical works. They will work in groups of 2-3 students. In all the session a final quiz/test will have to be filled by the students (PO b y k).

*) Tutorship: There will be up to four time slots for tutorship during the week. These slots can be used by students once they have applied for it by e-mail.

ASSESSMENT SYSTEM

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

The evaluation criterion is based on both a final exam (60% of the final mark) and a continuous evaluation (40% of the final mark).

The final exam (60% of the final mark) will consist of two parts:

1. Theory part (to be solved without class notes or books): quiz or short questions : 24% of the final mark (PO a y c).
2. Exercises part: 2 or 3 problems that can be solved using a handwritten summary of the formulae used in the course which hast to prepared by the student in advance: 36% of the final mark (PO a, c y e).

The continuous evaluation procedure (40% of the final mark) will consist of:

1. Two formative exams with a weight of 15% of the final mark each (30% of the final mark in total). They will include a quiz and/or short questions and/or exercises. The formulae needed to solve the exam will be provided (PO a, c and e).
2. The practical work corresponding to each of the four laboratory sessions will contribute up to 2.5% of the final mark (10% point of the final mark in total). In all the session a final quiz/test will have to be filled by the students (PO b, k).

BASIC BIBLIOGRAPHY

- CHENG D. K. Fundamentals of Engineering Electromagnetics, Addison Wesley, Pearson, 1993

- Carl T. A. Johnk Engineering Electromagnetic Fields and Waves, Wiley, 1998

- F. T. ULABY Fundamentals of Applied Electromagnetics, Prentice Hall, 2011

- VÁZQUEZ ROY, J.L., RAJO IGLESIAS, E. Course notes, Aula Global II.

ADDITIONAL BIBLIOGRAPHY

- BALANIS, C.A Advanced Engineering Electromagnetics, John Wiley and Sons, 2011

- Pozar, D. Microwave Engineering, John Wiley and Sons, 1998