High frequency techniques

Academic Year: (2022 / 2023) **Review date: 05-04-2022**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: VAZQUEZ ROY, JOSE LUIS

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The student must have similar knowledge to the one given in Electromagnetic Fields and Analysis and Design of Circuits.

OBJECTIVES

This subject deals with the analysis and understanding of the fundamental role of high frequency circuits (RF, microwave) and their associated techniques. The student will apply their mathematical and physical knowledge to the analysis and design of circuits for the transmission and reception of communications signals. In addition, they will be able to identify the circuits necessary for the development of a high frequency front-end by means of circuit simulation and the measurement of prototypes.

In particular, the objectives are the following:

1) To review the basic concepts of guided propagation explained in the subject Electromagnetic Fields: basic concepts of wave guides and transmission lines with an emphasis on their practical use.

2) To learn the use of circuit tools for the analysis of microwave circuits:
- -Knowledge of transmission line theory from a circuit theory point of view: Smith's chart.
- -Tools for the analysis of microwave networks: dispersion parameters (S).

3) To study the fundamentals and techniques used in the design of passive microwave circuits applied to:
- -The networks of two, three and four ports: dividers, combiners and directional couplers.
- -Passive non-reciprocal circuits.
- -Lumped and distributed resonators.
- -Microwave filters.

4) To study the problem of the analysis and design of microwave amplifiers.

5) To study the fundamentals of microwave measurements: impedance measurements and fundamentals of network analyzers.

DESCRIPTION OF CONTENTS: PROGRAMME

0. Introduction to Microwave Circuits
1. Review of waveguide and transmission line theory: practical transmission lines.
2. Circuit theory of transmission lines: Smith chart, impedance matching.
3. Microwave network analysis: S parameters.
4. Two, three and four ports passive microwave circuits: dividers and directional couplers. Introduction to non-reciprocal networks: circulators.
5. Microwave resonators.
6. Microwave filters.
7. Introduction to microwave measurements: impedance measurement and network and spectrum analyzers.
8. Introduction to microwave amplifiers.

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will consist of three parts:

- 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.
- 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.
- 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 individually or in groups of 2-3 students. In all the session a final quiz or a short report will have to be filled by the students.
- 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. In addition there will be other collective tutorship. Students are encouraged to make use of both teaching mechanisms.

ASSESSMENT SYSTEM

The evaluation criterion is based on both a final exam (60% of the final mark) and a continuous assessment (40% of the final mark).
The final exam will consist of an exam with 3 problems that have to be solved without books, although the formulae needed to solve the exam will be provided.
The continuous assessment procedure will consist of 2 exams with a weight of 15% and 20% of the final mark (35%).
The practical work will be a 5% of the final mark.

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

BASIC BIBLIOGRAPHY

- Daniel Segovia-Vargas et al Notes on Microwave course, OpenCourseWare de la Universidad Carlos III de Madrid, 2009
- David M.Pozar Microwave Engeneering, John Wiley & Sons, 2007
- Robert E. Collin Foundations for Microwave Engineering, McGraw-Hill, 1992

ADDITIONAL BIBLIOGRAPHY

- Bahl y Bhartia Microwave Solid State Circuit Design, Wiley Interscience, 1988
- Gupta, K.C.; Garg, R. y Chadha, R. Computer Aided Design of Microwave Circuits, Artech House, 1981
- J.M. Miranda, J.L. Sebastián, M. Sierra, J. Margineda Ingeniería de Microondas: Técnicas Experimentales, Prentice Práctica , 2002
- Rizzi Microwave passive circuits, John Wiley.
- Wadell, B.C. Transmisión Line Design Handbook, Artech House, 1991