High frequency technology

Academic Year: (2023 / 2024) **Review date: 29-08-2023**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: SEGOVIA VARGAS, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Networks analysis and synthesis, Electromagnetic Field Theory

OBJECTIVES

During this course the student will learn all the basic concepts on microwave circuits. In order to do that, the student will acquire knowledges in these areas:
- Analysis and design of passive devices and introduction to active microwave circuits.
- Study of the tools for the analysis and design of microwave circuits: Smith chart, S parameters.
- Analysis and design of passive microwave circuits: matching networks, power dividers, directional couplers, resonators and filters and non-reciprocal devices.
- Introduction to active circuits

Concerning skills, these can be generic or specific:
Specific skills:
- Review of the guided-wave propagation fundamental topics (taken from the course in Electromagnetic Field Theory) and transmission line theory.
- Knowledge of circuit theory to analyze microwave circuits:
  - Knowledge of transmission line as a circuit: Smith chart.
  - N-port network analysis: scattering (S-) parameters.
- Skills for the design of passive microwave circuits:
  - 2, 3 and 4-port networks: power dividers, combiners and directional couplers.
  - Resonator analysis
  - Analysis and design of microwave filters.
  - Introduction to passive non-reciprocal circuits.
- Introduction to microwave measurements: impedance measurement and network analyzers.
-Introduction to microwave amplifiers.

Basic Eurace skills

CB1: Students are able to aquire and understand advanced knowledge on specific subjects.

CB2: Students are able to apply their knowledge to solve telecommunication problems.

Generic Eurace skills

CG3: Knowledge of basic subjects and technologies.

Specific Eurace skills

ETEGITT2: Capacity to choose different RF and microwave circuits and subsystems for radiolinks and radar applications

Generic skills:
* Understanding the roll that RF front-ends have in a communication system. The student will be able to

apply his mathematics and physics knowledges to design circuits for transmitting or receiving communication signals. (PO a)
* The student will be able to identify the necessary circuits for designing an RF front-end with simulation tools (AWR or ADS software) and measure the corresponding prototypes (networks analyzer) (PO b, c, e and k)
* The student will be able to work in group and present the results of their work in an effective way (PO g, k)
* The student will understand the need of developing a continuous learning in order to update all the technological advances (PO a, c, j, k)

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 and graph theory.
4. Two, three and four ports passive microwave circuits: directional couplers and dividers.
Introduction to non-reciprocal networks: circulators.
5. Microwave resonators.
6. Microwave filters.
7. Introduction to microwave measurements: impedance measurement and network analyzers.

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. (PO a and c).
* 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 and e)
* Practical work in the laboratory. The students will be divided in groups of 20 students to realize the four proposed practical works (in 6 sessions). They will work in groups of 2-3 students. In all the session a final quiz will have to be filled by the students. (PO b and 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. In addition there will be other collective tutorship. Students are encouraged to make use of both teaching mechanisms.

ASSESSMENT SYSTEM

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

The evaluation criterion is based on both a final exam (45% of the final mark) and a continuous evaluation (55% 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 student has to take 4.5/10 in the final exam (PO a, c and e)
The continuous evaluation procedure will consist of 2 exams with a weight of 15% and 15% of the final mark (30%). (PO a, c and e)
The practical work will have a 15% of the final mark (the third practical work will be 12% weight and the first two practical works will be 3% weight) (PO b, k).
In addition there will be two quizes that comprise 10% of the grade

REQUIREMENT:
Knowledge of the subjects: Analysis and Design of Circuits and Electromagnetic Fields

BASIC BIBLIOGRAPHY

- Collin, Robert E. Foundations for Microwave Engineering, John Wiley & Sons, 2007

- Daniel Segovia Vargas Apuntes de Microondas y Circuitos de Alta Frecuencia, OCW, OCW, 2009

- Pozar, David M. Microwave Engineering, John Wiley & Sons, 2009

- Sorrentino, Roberto y Bianchi, Giovanni Microwave and RF engineering, John Wiley & Sons, 2010

- Steer, Michael Fundamentals of Microwave and RF Design, The University of North Carolina Press, 2019

BASIC ELECTRONIC RESOURCES

- Michael Steer . Microwave and RF Design: https://repository.lib.ncsu.edu/handle/1840.20/36776