

Academic Year: ( 2024 / 2025 )

Review date: 04-05-2024

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:
  - o Knowledge of transmission line as a circuit: Smith chart.
  - o N-port network analysis: scattering (S-) parameters.
- Skills for the design of passive microwave circuits:
  - o 2, 3 and 4-port networks: power dividers, combiners and directional couplers.
  - o Resonator analysis
  - o Analysis and design of microwave filters.
  - o Introduction to passive non-reciprocal circuits.
- Introduction to microwave measurements: impedance measurement and network analyzers.
- Introduction to microwave amplifiers.

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.
- 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).
- The student will be able to work in group and present the results of their work in an effective way.
- The student will understand the need of developing a continuous learning in order to update all the technological advances.

**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.

\* 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 proposed lab-works (in 6 sessions). The last four sessions will be devoted to the development of a global lab-work comprising all the concepts in the course. They will work in groups of 2-3 students. In all the session a final quiz 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

<b>% end-of-term-examination:</b>	45
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	55

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.

The continuous evaluation procedure will consist of 2 term exams with a weight of 15% and 15% of the final mark (30% ).

The practical work will have a 15% of the final mark (the third practical work will be 13% weight and the first practical work will be 2% weight).

In addition there will be two quizzes that comprise 10% of the grade.

Students who obtain in the weighted continuous assessment (without considering the final practical) a mark higher than 6.5/10 can obtain the final mark exclusively with the continuous assessment.

### 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>