Radio frequency and antenna subsystems

Academic Year: (2024 / 2025) **Review date: 28-08-2024**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: SEGOVIA VARGAS, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Students should have passed courses on Microwave circutis and antennas and electromagnetic fields and analysis and design of circuits.

OBJECTIVES

The student will aquire the following skills

- Capacity to design receivers and transmitters of RF, microwave and millimeters waves.
- Capacity to apply advanced knowledge of high frequency electronics
- Capacity to develop microwave subsystems for radiocommunications, radionavigation and radar
- Capacity to develop antennas for previous subsystems
- Capacity to implement cable and radio satellite communication systems.

DESCRIPTION OF CONTENTS: PROGRAMME

1) Radiofrequency subsystems
   1.1 Fundamentals of active and passive devices in microwave frequencies
      1.1.1 Diodes
      1.1.2. BJT and HBT transistors
      1.1.3. JFET, MESFET and HEMT transistors
   1.2 Linear and power microwave amplifiers
      1.2.1. High gain microwave amplifiers
      1.2.2. Low noise microwave amplifiers
      1.2.3. Introduction to power microwave amplifiers
   1.3 Microwave oscillators
   1.4 Detectors and mixers
      1.4.1. Non-linear performance of microwave diodes
      1.4.2. Passive mixers
      1.4.3. Active mixers
      1.4.4 Detectors and phase-shifters
   1.5 Introduction to microwave measurements
2) Antennas
   2.1. Fundamentals on radiation parameters
   2.2. Radiation integrals
   2.3. Elementary antennas: dipoles, loops and patches
   2.4. Array antennas: analysis
   2.5. Aperture antennas: horns and reflectors
   2.6. Introduction to antenna measurements

LEARNING ACTIVITIES AND METHODOLOGY

Three different activities are proposed: theory classes, problem classes and lab classes. The assignement of ECTS include the corresponding part of the student work.

- THEORY CLASSES. These classes use electronic or classical facilities. These classes include both theory classes and exercises to clarify the explanation. The students should take part in the class in a way as positive as possible.

- PROBLEMS. The students will have a collection of problems in advance so that they can prepare the solution of the problems in advance.

- Lab work. They basically consist on self-contained laboratory work.

ASSESSMENT SYSTEM

% end-of-term-examination:	45
% of continuous assessment (assigments, laboratory, practicals…):	55

The assesment system will validate whether the student has achieved the knowledge and the skills presented in previous sections.

The course is assessed by continuous assessment and final exam. Continuous assessment is carried out through:
1) Completion of a practical in 4 sessions. It has a weighting of 15%.
2) Partial exam on devices, amplifiers and oscillators. It will be held on October 29th and has a weighting coefficient of 15%.
3) Partial exam on antennas. It will be carried out by means of an exam on December 12th The weighting is 15%.
4) There are two partial tests with a total weighting of 10%.
5) Total continuous assessment 55%.
6) Final exam with a weighting of 45%.

Final mark
The final mark for the course will be obtained as the sum of 55% of the continuous assessment and 45% of the final exam.
In the final exam, a minimum mark of 4.5 must be obtained in order to obtain an average with the continuous assessment (the mark in the circuits part or in the antennas part cannot be lower than 4.0).
Students who obtain an average of more than 6,5 points in the continuous assessment (without the practical part), without having any continuous assessment mark lower than 6, can obtain their final mark as: 0,85*continuous assessment mark (without practical part)+0,15*practical part mark

BASIC BIBLIOGRAPHY

- Balanis Antenna Theory, Analysis and Design, Wiley, 2005

- Balanis Modern Antenna Handbook, Wiley, 2008

- Collin Foundations for microwave engineering, Mc Graw Hill, 1992

- Stutzman Antenna Theory and Design, Wiley , 1998

- Vendelin, Pavio, Rohde Microwave Circuit Design Using Linear and Nonlinear techniques, Wiley, 2005

ADDITIONAL BIBLIOGRAPHY

- Kildal Foundations of Antenna Engineering, Ed. Kildal, 2015

- Kraus Antennas and Wave Propagation, Mc Graw-Hill, 2016

- Sorrentino Microwave and RF Engineering, Wiley, 2010