Electronic components and circuits

Academic Year: (2022 / 2023) **Review date: 20-05-2022**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: PEREZ GARCILOPEZ, ANTONIA ISABEL

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics (1º, 1C), Sistems y Circuits (1º, 2C)

OBJECTIVES

The objective of this course is to achieve the basic training of the student on the electronic instruments used in lab, the electronic devices and the electronic circuits, and the application of this knowledge to solve some engineering problems related to electronic components and circuits.

In order to achieve this objective, it is the aim of this course that the student will obtain the following knowledge and abilities:
- A knowledge of how passive and active electronic devices work and their main applications.
- A knowledge of the electronic instruments, the measuring methods and techniques.
- An ability to analyze the main parameters of single and multi-transistor amplifiers in small-signal domain.

The specific skills that are developed in this course are the following:
- An ability to apply the knowledge of circuits analysis, the analysis of electronic circuits with passive components, active devices and amplifiers, in transient regime and stationary regime, by using partial derivative equations and the response in the frequency domain.
- An ability to characterize the electronic parameters associated to passive components and to amplifier circuits. In addition, an ability to interpret the results comparing them with manufacturer data sheets.
- An ability to solve real problems through orientated exercises that are related to each thematic block and global case studies that involve the total contents of the course.
- Knowledge of different instruments and measurement techniques and an ability to manage them in the laboratory, the use of commercial simulation tools and their application to characterize electronic circuits complimentarily.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Electronic and Photonic Components. Application Circuits and Characterization

   1.1 Passive components
   1.2 Analysis of passive components circuits
   1.3 Laboratory instrumentation and measurement techniques
   1.4 CAD tools for electronic circuits simulation
   1.5 Fundamentals of semiconductors. Diodes and application circuits
   1.6 Transistors. Bias circuits.
   1.7 Photonic devices. Applications.
   1.8 Introduction to microsystems

2. Electronic Signal Amplifiers

   2.1 Basic concepts and amplifiers parameters
   2.2 Signal amplifiers with discrete Components. Medium frequency operation and configurations.
   2.3 Current sources and differential pair
   2.4 Active loads and integrated amplifiers
   2.5 Ideal OpAmp and application circuits

3. Frequency response

3.1 Frequency response introduction
3.2 Frequency behavior of amplifiers bandwidth concept, cutoff frequencies. Components affecting frequency response

LEARNING ACTIVITIES AND METHODOLOGY

During the first weeks of the course (10 sessions), a flipped classroom methodology will be used. Each week the students should watch the videos and complete the self-assessment activities of 1 or 2 modules of the SPOC "Basic concepts for electronic circuits and components". During the face-to-face classes of the week, practical activities will be carried out to reinforce the contents of the SPOC modules, including exercise classes, computer simulations and practical assemblies in the laboratory. In the remaining 19 sessions, a methodology based on lectures, practical classes for solving exercises and laboratory sessions will be developed.
Overall, during the 29 face-to-face sessions of the course, the training activities are organized as following:
- 25% Lectures (1.5 ECTS) where the main concepts are presented on the basis of mathematical tools and circuit analysis tools. The learning materials include the lecture notes, the classroom documentation, and the basic bibliography that is used as a reference for completing the themes and study them in depth.
-60% Practical classes (3.6 ECTS) that are focused on solving exercises and case studies, and also on the ongoing evaluation. These classes are completed with the exercises and practical problems that are solved by the students at home. The methods of solving these cases are complemented with the use of computer simulation tools.
- 15% Laboratory sessions (0.9 ECTS) where the students analyze, implement and measure in the laboratory basic electronic circuits with real application using the instrumentation and the measurement techniques.
- Group tutorial: At least a group tutorial will be carried out the recovery week as revision and final exam preparation.

ASSESSMENT SYSTEM

The assessment is based on the following criteria:
a) LABORATORY PRACTICES: They are compulsory. In these practices the knowledge acquired by the student will be assessed with the development of some practical cases, previously studied in the theory and problems lectures. (20% of the final score). Before the laboratory sessions, it will be necessary to take the laboratory skills certification course (SPOC).
b) MIDTERM EXAMS, (40% of the final score).
c) FINAL EXAM (mandatory). The ability of the student to analyze and/or design electronic circuits, and their characterization. This exam has a weight of 40% in the final score if the student follows the continuous assessment. A minimum qualification of 4.0 is required in this final exam to pass the subject.
d) Evaluation activities that will be carried out in Aula Global about the contents of the SPOC "Basic concepts for electronic circuits and components" (Bonus of up to 1 point in the student's final grade, if the continuous assessment process is followed)

Extraordinary Call
Assessment can follow the same criteria of continuous assessment process (with the same percentages as in ordinary exam) or established through a final exam with the 100% of qualification.

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

BASIC BIBLIOGRAPHY

- Adel S. SEDRA y Kenneth C. SMITH Microelectronic Circuits, Oxford University Press, 5th edition, ISBN: 978-0195142525, 2004
- Albert P. MALVINO and David J. BATES Electronic Principles, McGraw-Hill, 7th edition, ISBN: 007-297527-X, 2007
- Robert F. COUGHLIN, Frederick F. DRISCOLL Operational Amplifiers and Linear Integrated Circuits, Prentice Hall, 6th Edition, ISBN: 978-0130149916, 2000

ADDITIONAL BIBLIOGRAPHY

- Adel S. SEDRA y Kenneth C. SMITH Microelectronic Circuits Revised Edition, Oxford University Press, 7th edition, ISBN: 978-0195338836 (2007).
- Jacob MILLMAN, Arvin Grabel Microelectronics, McGraw-Hill, ISBN: 978-0071005968 (1988).
- Paul HOROWITZ, Winfield HILL The Art of Electronics, Cambridge University Press, 2nd edition, ISBN: 978-0521370950 (1989).

BASIC ELECTRONIC RESOURCES

- José A. GARCÍA SOUTO, Isabel PÉREZ GARCILÓPEZ, Pablo ACEDO GALLARDO, Enrique SAN MILLÁN, Celia LÓPEZ ONGIL . OpenCourseWare (OCW) - Electronic Components and Circuits (2010): http://ocw.uc3m.es/tecnologia-electronica/electronic-components-and-circuits