



Code: ING-INF/07

Credits: 9

Matter: Electrical and Electronic Measurements

Main language of instruction: Italian

Other language of instruction: English

Teaching Staff

Head instructor

Prof. Pietro Oliva - pietro.oliva@unicusano.it

Introduction

1. Objective of the course :

The course is intended to provide the fundamentals about the basics of electric and electronic measurements with particular regard to the use of the multimeter and the oscilloscope in the standard laboratory practices and the related applications. The course will focus on the definition of the physical parameters needed to characterize the behavior of the main instruments and on the discussion of the main features currently used in different applicative scenarios.

Objectives

2. Course Structure:

The course is organized in four modules in which there is a main subject of interest.

- The first subject summarizes the basics of measurements: an introduction to statistics: expected value of a measurement and PDFs: Bernoulli, Poisson, Gauß. accuracy, precision, resolution, reliability, repeatability, validity, uncertainty, errors and their analysis, standards of measurement.
- The second subject is focused on circuit theory, direct current, ammeter and multimeter, Different types of systems & networks: Lumped approximation, Passive Networks. Kirchhoff theorems and their applications in circuit analysis.
- The third module provides the fundamentals to Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, X-Y mode, Probes, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Sampling and Digital

Oscilloscope; signal generators: sine wave generator, Pulse and square wave generators. Alternate Current and sinusoidal steps waveforms for RL, RC, LC and RLC Circuits.

- The fourth module deals with semi-conductors and further insights.

Competencies:

- Understanding of the physical phenomena regulating the transmission and reception of the electric signals within a circuit network and of the relative mathematical tools;
- Ability to characterize and to understand the performances of a passive filter of the first and second order in a circuit.
- Ability to Operate and Maintain various electronic, test and measuring instrument.
- Ability to design different categories of filters and circuit satisfying the design specifications.

Syllabus

3. Programme of the course:

Subject 1. Introduction

Fundamentals of electromagnetic theory. Maxwell equations. International System, measurement basics, Introduction to statistical analysis, histogram and binning, main PDFs.

Subject 2. Fundamentals of Lumped circuit approximation

Introduction. Circuit elements, Generators (ideal and real), series and parallel, Kirchhoff laws, Thévenin and Norton, ammeter.

Subject 3. CC & Ammeter/multimeter

Passive circuits, first order filters, second order filters, Fourier analysis, symbolic method and Laplace transform.

Subject 4. CA & Oscilloscope

AC, sinusoidal feed to first order filters, differentiator and integrator circuits, Oscilloscope.

Evaluation system and criteria

The assessments of course is based on the following criteria:



4. Final exam (85 %)
5. Homework (15 %)

The final exam consists of three exercise.

The homework consists in the writing of a technical report containing the results of simulations of relevant circuits.

Bibliography and resources

6. Materials to consult:

- Lecture notes
- Recorded and live lectures

7. Recommended bibliography:

- Neil Storey, "Electronics: A Systems Approach" Pearson Education Limited
- Ernest O. Doebelin, "Measurement Systems: Application and Design", Mcgraw-Hill College.