UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Laboratorio di Elettronica II

2324-1-F1701Q146

Aims

The Laboratory of Electronics II course is divided into two sections:

- study and simulation of analog circuits using Computer-Aided-Design (CAD) software;
- electrical characterization of simple analog circuits in the laboratory (using specific instrumentation (power supply, signal generator, oscilloscope, spectrum analyzer, etc)).

More specifically, the objectives of the course are focused on acquiring skills in:

- Integrated Analog Circuit Design (Operational Amplifiers, Analog Filters, Charge-Sensitive Amplifiers, Low Noise Amplifiers for Sensors) in deeply scaled down CMOS Technology;
- Learning of Computer-Aided-Design (CAD) tools for the characterization of integrated circuits (simulations under nominal conditions and varying temperatures, including physical and electrical deviations of the CMOS process);
- Characterization of Analog Circuits in both static (operating point) and dynamic (time and frequency) domain;
- Study and characterization of the Noise Power Spectral Density (input and output) of the Amplifiers;
- Electrical characterization in the laboratory of simple analog circuits.

Contents

- Introduction to Analog Circuits Design by Computer-Aided-Design (CAD)
- CMOS Design of Operational Transconductance Amplifiers (OTA)
- Operational Transconductance Amplifiers Design Procedure
- Nominal Conditions Simulations (operating point, frequency, time, noise in both time and frequency domain, closed-loop stability)
- Noise Power Spectral Density in Closed-Loop Circuits

- Process-Voltage-Temperature Simulations
- Montecarlo Simulations
- Circuital exercises in the laboratory

Detailed program

Lesson 1: Miller-Compensated Operational Transconductance Amplifiers (OTA)

- Introduction
- Class-A OTA Basic Scheme
- OTA Operating Point
- Small-Signal
- Large-Signal
- Noise: Class-A OTA Input Referred Noise
- Common-Mode Feedback Circuit

Lesson 2: Miller OTA Design Procedure

- Introduction
- Opamp Specifications
- Input Differential Stage
- Miller Capacitance
- Class-A Output Stage
- Class-AB Output Stage
- Common ModeFeedback Circuit

Lesson 3: CAD Tools

- Creating a schematic and symbol.
- Simulating simple analog circuits using Analog Design Environment.
- Running process/voltage/temperature simulations.
- Running Montecarlo simulations.

Prerequisites

Bachelor in physics or equivalent.

Teaching form

Preferably the lessons will be held in frontal mode.
All lessons will be recorded and available in synchronous streaming.

Textbook and teaching resource

- Lecture notes provided by the instructor
- Johns, David A., and Ken Martin. *Analog integrated circuit design*. John Wiley & Sons, 2008.
- Sansen, Willy M. *Analog design essentials*. Vol. 859. Springer Science & Business Media, 2007.

Semester

second semester

Assessment method

Oral examinations in presence.
The student will present two Laboratory Reports based on:

1. Design and simulation of analog circuits (whose general scheme will be provided by the course teachers during the lessons);
2. Electrical and electronic measurements on simple circuit configurations.
   The exam will consist of:

- Colloquium on Laboratory Relations
- Colloquium on topics covered during the lesson

In case of limitations due to Covid-19 pandemic, exams will be online using WebEx. A dedicated news will be posted on the e-learning page of the course with a public link to freely access the virtual room where the exam will take place.

Office hours

Discussions with prof. Marcello De Matteis will take place in person or using the WebEx upon appointment (contact via mail marcello.dematteis@unimib.it).

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE