**Code:** **LM-29** **Credits: 9**
**Matter:** **Electronic Systems Design**
**Main language of instruction:** Italian
**Other language of instruction:** English

## Teaching Staff


### Head instructor

**Prof. Stefano Salvatori -**
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## Introduction

1. *Objective of the course*

The course aims at providing fundamental elements on the design of analog and digital electronic systems. Basic concepts, as band-gap voltage reference, fast (as well as slow) circuitry for signal amplification and conditioning, are developed starting from examples highlighting the designer's point of view. Some space is given to microprocessor/microcontroller based systems and microprocessor architecture design is developed for the simples minimum processor (MU0). ARM7 architecture is also illustrated as a fundamental example of RISC processor design.
E-tivities (*Electronic-Activities*) are proposed as Case-Studies and Self-Assessment Tests. Both are designed to deepen some key topics of the course, and useful for final grade. Main purpose of the course is to attract the student interest on method of analysis and synthesis of circuit solutions closest as possible to real situations.

## Objectives

2. *Course Structure*

The course is organized into four main subjects.
The first subject is related to case studies of design example as: precision signal integration; power supply; audio line driver and audio filtering; radio-frequency current-to-voltage converters. The circuits explored in the mentioned case-studies allow to get a deeper insight on fundamental solutions: switched capacitors amplifiers/integrators; band-gap references; over-temperature and over-current control circuitry; filter design; BJT-based amplifier design.
The second subject concentrates on current-feedback operational-ampli-

fiers which represent the fundamental components in high-speed analog circuit design.
The third subject deals on A-D conversion, underlining the sigma-delta converters architecture.
Finally, the last part of the course focuses on the architecture of microprocessor-based systems. The design of a minimum processor is used to show the adopted methodology in designing such kind of systems.

## Competencies

*Knowledge and understanding*

- to know and understand the terminology, properties and physical quantities involved in particular circuit solutions;
- to remember the peculiar characteristics of some circuit solutions, also taking inspiration from the designer's point of view;
- to recognize both elementary and advanced circuit solutions, based on analog devices of the standard type, and analyze them to understand their specific characteristics and their respective advantages and disadvantages;
- to remember some basic models of components and circuits;
- to memorize the analytical techniques necessary to understand the functioning of an electronic system.

*Application of knowledge*

- to use appropriate terminology when describing an electronic system;
- to describe the basic principle of some integrated components (chosen as examples of a particular technology or circuit solution);
- interpreting the scheme of a circuit also complex, mainly from the designer's point of view, even with a practical, yet rigorous, approach.

*Ability to draw conclusions*

- to choose a specific circuit solution according to requirements and specifications;
- to identify the circuit blocks and their interconnections responding to a particular application;
- interpreting the obtained results both in terms of physical coherence and in terms of engineering feasibility.

*Communication skills*

- to develop a correct and comprehensible technical-scientific language with which to express in the clearest and most unambiguous

way the technical knowledge acquired in the field of electronic circuit theory.

*Ability to learn*

- applying foreground for the resolution of unfamiliar problems involving the acquisition and processing of signals using integrated electronic circuits and solid-state electronic devices.

## Syllabus

*3. Course Program*

**Subject 1.** Project examples
- front-end electronics for weak current-signals;
- precision power supply;
- audio filters;
- radio-frequency amplifier.

**Subject 2.** Current feedback operational amplifier
- basic structure;
- applications;
- datasheet analysis.

**Subject 3.** Analog-to-digital conversion
- basic solutions;
- weighted capacitors successive approximation solution;
- sigma-delta architecture.

**Subject 4.** Microcontroller based embedded systems
- microprocessor architecture:
- RISC and CISC;
- minimum processor design;
- ARM based RISC processors.

## Evaluation system and criteria

Verification of the achievements is carried out through evaluation of the E-tivities and of a Profit Exam, which consists of a written test.

## Bibliography and resources

4. *Materials to consult*

Provided video-lectures, slides and notes will cover the whole program and they contain the necessary material to assess the course.

5. *Recommended bibliography*


- M. Thompson, Intuitive Analog Circuit Design, Newnes-Elsevier, 2006;
- R. A. Pease, Troubleshooting Analog Circuits, Newnes-Elsevier, 1999;
- Analog-Digital Conversion, W. Kester ed., Analog Devices, www.analog.com;
- S. Fuber, ARM System-on-chip Architecture, Pearson, 2001.