



# UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

## VLSI ANALOG-DIGITAL INTERFACE ICS

<b>Anno immatricolazione</b>	2020/2021
<b>Anno offerta</b>	2021/2022
<b>Normativa</b>	DM270
<b>SSD</b>	ING-INF/01 (ELETTRONICA)
<b>Dipartimento</b>	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
<b>Corso di studio</b>	ELECTRONIC ENGINEERING
<b>Curriculum</b>	Photonics
<b>Anno di corso</b>	2°
<b>Periodo didattico</b>	Primo Semestre (27/09/2021 - 21/01/2022)
<b>Crediti</b>	6
<b>Ore</b>	51 ore di attività frontale
<b>Lingua insegnamento</b>	English
<b>Tipo esame</b>	SCRITTO E ORALE CONGIUNTI
<b>Docente</b>	MANSTRETTA DANILO (titolare) - 6 CFU
<b>Prerequisiti</b>	The course assumes good knowledge of the basic electronic circuits (bachelor electrical-engineering courses).
<b>Obiettivi formativi</b>	<p>The main aim of the course is to provide an introduction to the design of a vast area of analog/digital interface circuits and systems: sensors, transducers, wireless and wireline front-ends, electro-optical front-ends, etc...</p> <p>At the end of the course the students will be able to identify the main type and architectures of filters (including equalizers) and analog/digital, digital/analog converters used in these systems.</p> <p>They will be able to provide the general guidelines for the selection and design of the appropriate type and architecture of filters and analog/digital converter architectures based on the specifications of the analog/digital interface to be implemented. They will also have the tools to study and develop new architectures using the most advanced CAD</p>

## Programma e contenuti

tools and techniques.

The course is structured in two parts: the first part is dedicated to the design of the main types of analog integrated filters, the second part provides an introduction to the design of the main architectures of D / A and A / D converters.

Lectures are complemented by the laboratories, which address the analysis and design issues, at the architectural and circuit-level, with the help of CAD tools. The various projects carried out in laboratories cover the area of A / D and D / A converters and different types of integrated filters, such as SC, and RC active gm-C.

### Analog Filters

This part of the course deals with the design of various types of switched-capacitors and continuous-time analog filter architectures. The emphasis is on the architecture and on the key performances limitations/trade-offs. Specific circuit design examples will be discussed that are compatible with scaled CMOS VLSI implementations.

- Types of filters.
- Normalizing and de-normalizing: scaling in frequency and impedance.
- Frequency transformation.
- Transfer function approximations: Butterworth, Chebyshev and elliptic.
- Passive networks synthesis: single-terminated and double-terminated networks.
- Active-RC type filters: biquadratic cells and ladder type filters.
- Transconductance-based Filters (gm-C)
- Switched-Capacitor Filters

### A/D and D/A converters

This part of the course deals with the design of A/D and D/A converters. The emphasis is on the analysis and design of the different converter architectures and on the related performance limitations/trade-offs.

- ADC Introduction: performance metrics
- Basic building blocks: amplifiers, comparators, S / H circuits
- Flash and two-step flash architectures
- Pipeline structures
- Folding and interpolating structures
- Successive approximation converters (SAR)
- Interleaved converters
- Sigma-delta converters
- DAC Introduction: performance metrics
- D/A converters design: operating principles (scale of resistors, current division and charge division), circuit examples, yield estimation

## Metodi didattici

Lectures (hours/year in lecture theatre): 42

Practical class (hours/year in lecture theatre): 0

Practicals / Workshops (hours/year in Lab): 9

	<p>Lectures are carried out using overhead projector. The slides are made available to the students e prior to the lecture. The slides from previous years are available on KIRO. Practical activities consists in circuit simulations and are carried out with CAD software.</p>
<p><b>Testi di riferimento</b></p>	<p>During the course the instructor will provide students with the lectures notes.</p> <p>For further reference:</p> <p>Kendall Su, Analog Filters, Second Edition, Kluwer Academic Publisher Group, The Netherland</p> <p>B. Razavi, Principles of Data Conversion System Design, IEEE Press</p> <p>R. van de Plassche, Integrated Analog-to-Digital and Digital-to-analog Converters, Kluwer Academic Publisher</p>
<p><b>Modalità verifica apprendimento</b></p>	<p>The final evaluation consists of a written test followed by oral discussion. The test consists of one circuit analysis exercise which provides an evaluation of the design skills and 10 multiple-choice questions that covers all the major subject areas of the course. The final score is based 50% on the exercise and 50% on the questions. There is no threshold to be admitted to the oral exam.</p>
<p><b>Altre informazioni</b></p>	<p>Information on course contents are available on the new KIRO platform:</p> <p><a href="https://elearning.unipv.it/course/view.php?id=57">https://elearning.unipv.it/course/view.php?id=57</a></p>
<p><b>Obiettivi Agenda 2030 per lo sviluppo sostenibile</b></p>	<p><a href="#">Sbl legenda sviluppo sostenibile</a></p>