

Progettazione Mixed Signal

(Design of Mixed Signal Circuits and Systems)

CFU: 9 (90 ore)

A.A. 2023-2024

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The Sensor Systems Engineering program (15 CFU)

Curriculum: **Sensor System Engineering**

- ❑ Sistemi sensoriali per l'automazione, l'ambiente e la salute (6 cfu)
- ❑ Progettazione *mixed signal* (9 cfu)



- ❑ **Design of integrated cells for:**
 - Sensor interfacing
 - Analog control systems
 - Analog signal processing
- ❑ **Data conversion (ADCs & DACs)**
- ❑ **Digital and Analog circuit integration**

Main Topics (not in chronological order)

1) High level description of a collection of fundamental Analog and Mixed Signal (AMS) systems:

- DAS (Data Acquisition Systems) and elementary sensor interfaces
- Methods for offset and flicker noise cancellation
- Fully-differential architectures
- Analog Integrated Filters
- Data converters (ADC-DAC)

2) Complement of Mixed Signal Analysis & Design Methods

- Design friendly MOSFET and BJT noise models
- Useful network theorems (feedback system design, parameter variation effects, ...)
- Mixed Signal design flow

3) Transistor level Analysis & Design of main analog cells

- Elementary blocks: Switches and Current Mirrors
- Operational amplifiers (S/E and Fully-Differential)
- Integrated Comparators

Experimental Lectures

- 1) Design and Simulation of a few important analog blocks (LTSpice)
- 2) Experiments performed by the teacher with dedicated analog circuits and computer-controlled oscilloscopes / signal generators

Final Exam

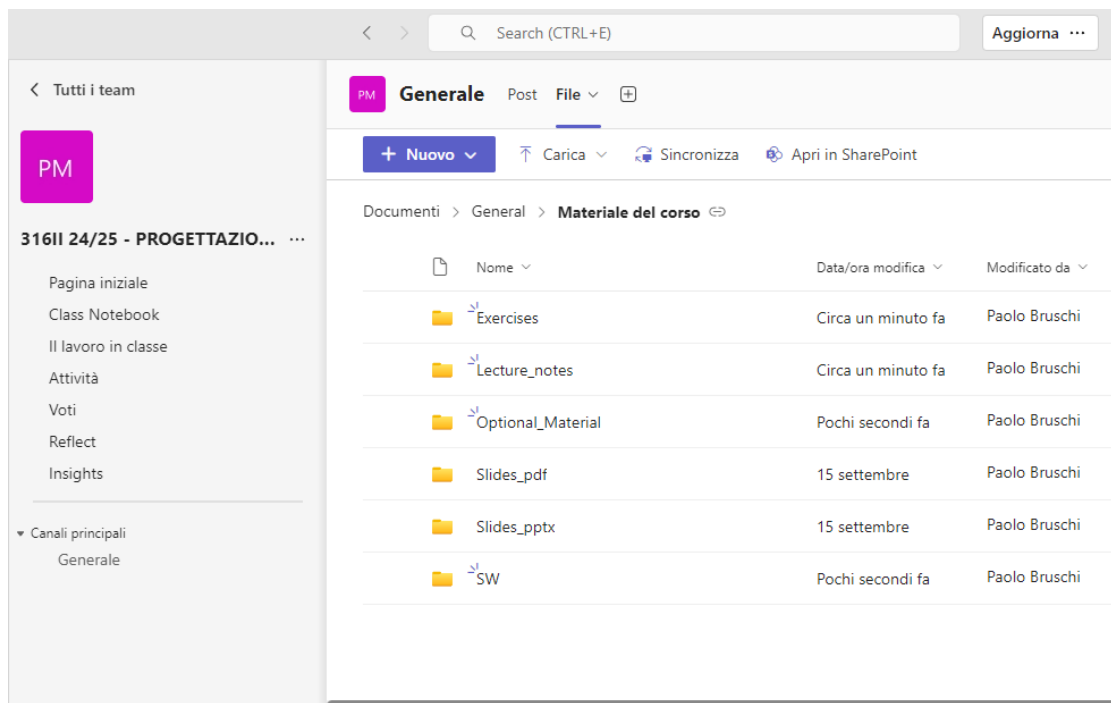
- 1) Only oral: typically, two questions (transistor-level topic + system level topic)

Suggested Prerequisites

- 1) Progettazione di Sistemi Microelettronici (PSM)
- 2) Elettronica Analogica

Didactic Material

Available on the Teams "File" section



The material will be made available progressively

Didattic material (2023 version)

From teacher's web page: (<http://www2.ing.unipi.it/~a008309>)

→ http://www2.ing.unipi.it/~a008309/mat_stud/lista_dida.html

The image shows a screenshot of a web directory listing. On the left, there is a list of items: 'Parent Directory', '2023/' (with a folder icon), and 'archive/' (with a folder icon). The '2023/' item has a red arrow pointing to it from the text 'Past years material' below. The 'archive/' item has a red arrow pointing to it from the text 'Past years material' below. A red arrow also points from the 'archive/' item to a larger directory listing on the right. The right listing is a detailed view of the 'archive/' directory, showing sub-directories: 'Exercises/' (2023-09-24 12:19), 'Lecture_notes/' (2023-09-24 12:19), 'Optional_Materials/' (2023-09-24 12:19), 'SW/' (2023-09-24 12:19), 'Slides/' (2023-09-24 12:18), and 'Slides_pdf/' (2023-09-24 12:18). A red bracket groups these sub-directories.

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Parent Directory	-	-
2023/	2023-09-24 12:19	-
archive/	2023-09-24 12:17	-

Item	Timestamp	Size
Parent Directory	-	-
Exercises/	2023-09-24 12:19	-
Lecture_notes/	2023-09-24 12:19	-
Optional_Materials/	2023-09-24 12:19	-
SW/	2023-09-24 12:19	-
Slides/	2023-09-24 12:18	-
Slides_pdf/	2023-09-24 12:18	-

Past years material