EPFL

EE-523   **Advanced analog integrated circuit design**

Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Remark

Pas donné en 2023-24

Summary

Introduction to advanced topics in analog and mixed-signal CMOS circuits at the transistor level. The course will focus on practical aspects of IC design, quantitative performance measures, and design trade-offs to develop an intuitive understanding of circuit behavior.

Content

- Advanced topics on CMOS operational amplifiers
- Review of noise, feedback and stability
- Switched-capacitor circuits
- Design of low-power, low-noise analog front-ends
- Noise efficiency and gain-bandwidth considerations
- Dynamic analog techniques
- Comparators and data conversion circuits
- Data compression and machine learning circuits
- Nonlinearity and mismatch
- Layout, short-channel effects, IC fabrication

Keywords

CMOS, advanced analog integrated circuits, mixed-signal IC design, low-noise analog front-end, noise efficiency factor, biomedical circuits, biopotential amplifier

Learning Prerequisites

Recommended courses

- Analog IC design (EE-320)
- Fundamentals of analog & mixed signal VLSI design (EE-424)

Important concepts to start the course

- MOS transistor operation, large/small signal models, parasitics
- Time and frequency (Laplace) domain analysis
- Single-stage, multi-stage, and differential CMOS amplifiers
- Noise, stability, and feedback concepts

Learning Outcomes

By the end of the course, the student must be able to:

- Design and analyze large, complex circuits
- Develop an intuition for analog and mixed-signal circuit behavior
- Design and layout a circuit in Cadence
- Recognize fundamentals of low-power sensor interfaces

Transversal skills

- Demonstrate the capacity for critical thinking
- Access and evaluate appropriate sources of information.

Teaching methods

Weekly 2 hour lectures, 1 hour exercise sessions, homework, and practical work (use of CAD tools for IC design)

Expected student activities

Following the lectures and exercise sessions, completing the assigned homework based on lectures and exercises, simulating circuits in Cadence

Assessment methods

Written

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

- Lecture slides
- Design of Analog CMOS Integrated Circuits, 2nd Edition, B. Razavi, McGraw-Hill
- Analysis and Design of Analog Integrated Circuits / Gray, 5th Edition, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, Wiley