Fundamentals of Analog & Mixed Signal VLSI Design

Introduction

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Summary, Aims and Objectives

- Summary
  - This course presents the design of low-power analog CMOS integrated circuits. The techniques are based on the concept of inversion coefficient that can be used as the main design parameter for the optimization of figures-of-merit applied to circuits including amplifiers, filters and oscillators
- Course aims
  - To understand what conditions the power consumption of analog circuits
  - To present a methodology for the design of low-power analog CMOS ICs
  - To explain the concept of inversion coefficient and how it can be applied for the design of low-power analog circuits
- Learning objectives
  - To learn how to design basic analog CMOS integrated circuits
  - To design simple analog building blocks according to specs
  - To verify by circuit simulations that the specs have been achieved

Syllabus

1) Introduction
2) Technology roadmap
3) Modeling of the MOS transistor for low-power design
4) The concept of inversion coefficient and G_m/I_D design methodology
5) Optimization of basic figures-of-merit
6) Amplifiers (OTAs and OPAMPs)
7) Offset and 1/f noise reduction techniques
8) Continuous-time (CT) filters design
9) Switched-capacitors (SC) filters design
10) Oscillators

Program

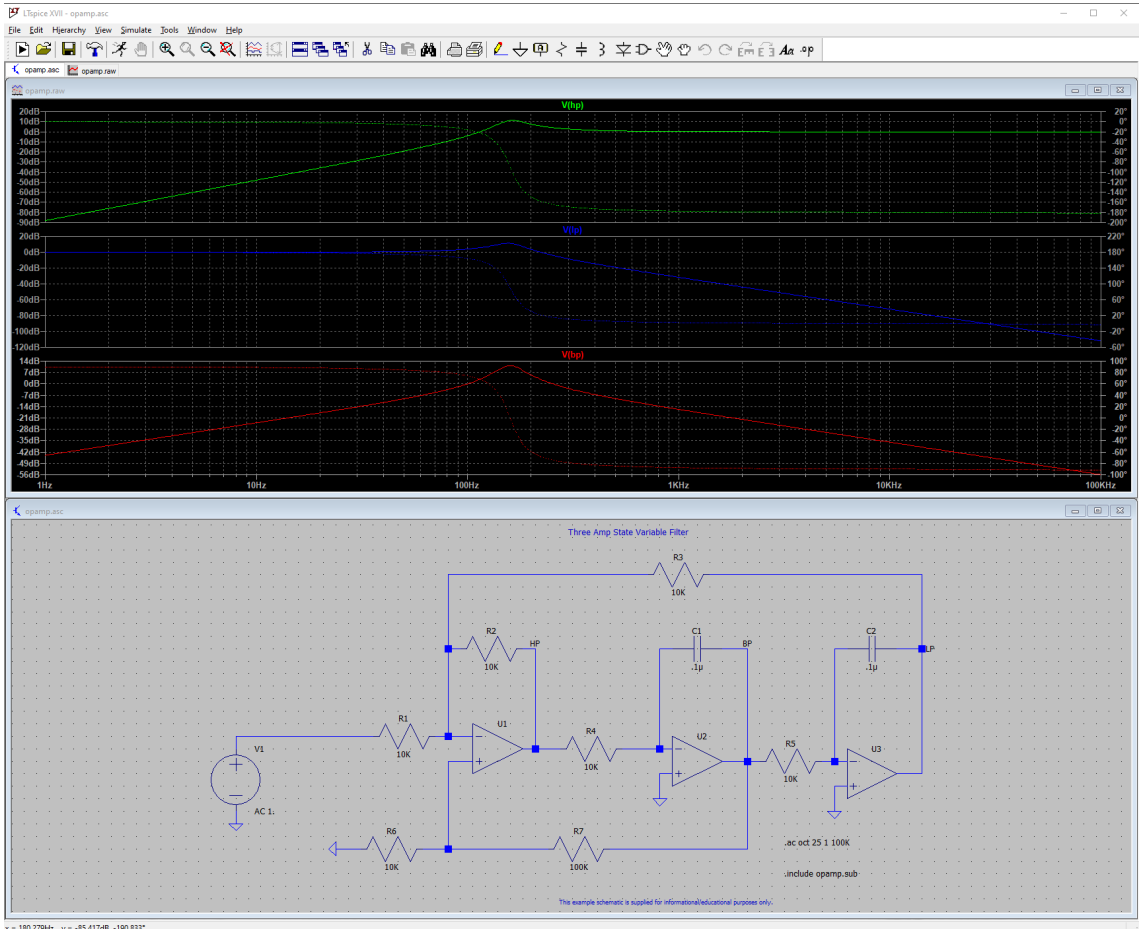
Lecture #	Date	Topic
1	11.09.2024	Introduction Technology roadmap
2	18.09.2024	Modeling of the MOS transistor for low-power design (long-channel)
3	25.09.2024	Modeling of the MOS transistor for low-power design (short-channel)
4	02.10.2024	Noise in circuits and systems
5	09.10.2024	The concept of inversion coefficient and Gm/ID design methodology
6	16.10.2024	Basic building blocks
	23.10.2024	Fall break
7	30.10.2024	Amplifiers (OTAs and OPAMPs) Part 1
8	06.11.2024	Amplifiers (OTAs and OPAMPs) Part 2
9	13.11.2024	Offset and 1/f noise reduction techniques
10	20.11.2024	Continuous-time filters (CTFs)
11	27.11.2024	Switched-capacitors circuits and filters (SCF)
12	04.12.2024	Reference circuits
13	11.12.2024	Oscillators
14	18.12.2024	Comparators

Teaching Methods

- Two hours **lectures** based on the slides accessible from the corresponding moodle site
- The lecture will be given in person
- Computer tools will be used for the **analysis** and the **design** (Juypyter Notebooks) and **verification** will be done with a circuit **simulator** (Ltspice or Smash)
- **Homework** to prepare and validate the work done during the exercise and simulation sessions

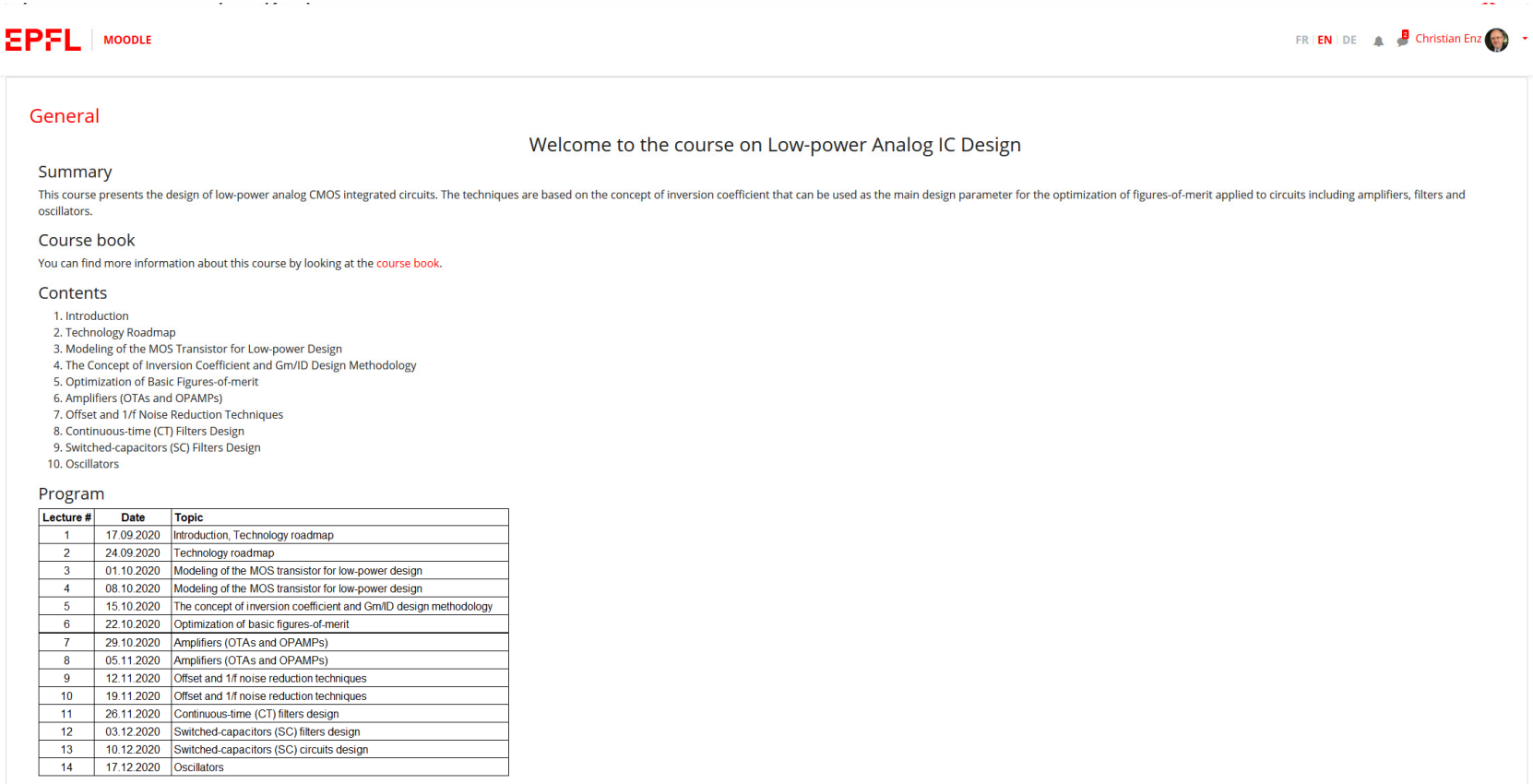
Tools

- **Analysis** and **design** will be carried out with **Jupyter Notebooks**
- Circuit **simulation** will be carried out with **LTSpice** or **Smash**



Moodle Site

- Information on the course, slides, exercises, homework can be found on the moodle site



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General

Welcome to the course on Low-power Analog IC Design

Summary

This course presents the design of low-power analog CMOS integrated circuits. The techniques are based on the concept of inversion coefficient that can be used as the main design parameter for the optimization of figures-of-merit applied to circuits including amplifiers, filters and oscillators.

Course book

You can find more information about this course by looking at the course book.

Contents

1. Introduction
2. Technology Roadmap
3. Modeling of the MOS Transistor for Low-power Design
4. The Concept of Inversion Coefficient and Gm/ID Design Methodology
5. Optimization of Basic Figures-of-merit
6. Amplifiers (OTAs and OPAMPs)
7. Offset and 1/f Noise Reduction Techniques
8. Continuous-time (CT) Filters Design
9. Switched-capacitors (SC) Filters Design
10. Oscillators

Program

Lecture #	Date	Topic
1	17.09.2020	Introduction, Technology roadmap
2	24.09.2020	Technology roadmap
3	01.10.2020	Modeling of the MOS transistor for low-power design
4	08.10.2020	Modeling of the MOS transistor for low-power design
5	15.10.2020	The concept of inversion coefficient and Gm/ID design methodology
6	22.10.2020	Optimization of basic figures-of-merit
7	29.10.2020	Amplifiers (OTAs and OPAMPs)
8	05.11.2020	Amplifiers (OTAs and OPAMPs)
9	12.11.2020	Offset and 1/f noise reduction techniques
10	19.11.2020	Offset and 1/f noise reduction techniques
11	26.11.2020	Continuous-time (CT) filters design
12	03.12.2020	Switched-capacitors (SC) filters design
13	10.12.2020	Switched-capacitors (SC) circuits design
14	17.12.2020	Oscillators

Evaluation

- Final open book exam will be a MCQ done in Moodle