Advanced Integrated Circuits

Avancerade integrerade kretsar
6 credits

Programme course

TSEK13

Valid from:

Determined by	**Main field of study**	
	Electrical Engineering	
Date determined	**Course level**	**Progressive specialisation**
	Second cycle	A1F
Revised by	**Disciplinary domain**	
	Information missing	
Revision date	**Subject group**	
Offered first time	**Offered for the last time**	
2026		
Department	**Replaced by**	
Institutionen för systemteknik		

Course offered for

- Master of Science in Applied Physics and Electrical Engineering - International
- Master of Science in Computer Science and Engineering
- Master of Science in Applied Physics and Electrical Engineering
- Master's Programme in Electronics Engineering

Prerequisites

Analog CMOS Integrated Circuits

Intended learning outcomes

This course is intended to give knowledge and experience in designing advanced integrated circuits for system-on-chip applications using micro- and nano-scale CMOS technologies. Additionally, it covers layout and packaging principles, with a focus on the challenges and effects that arise when analog, digital, and RF circuits coexist on the same chip. After the course, students should have the following knowledge and skills:

- Understand advanced CMOS integrated circuit design challenges and possibilities.
- Be able to analyze advanced integrated circuits
- Have in-depth knowledge and skill in analysis, design, and evaluation of integrated circuits such as advanced operational amplifiers, reference generators, switched-capacitor circuits, digital-to-analog and analog-to-digital converters and other versatile CMOS building blocks.
- Have skill and experience in using professional circuit simulators for design and evaluation of integrated circuits in presence of noise as well as process, voltage, and temperature variations.
- An understanding of layout and packaging principles

Course content

The course will focus on these topics:

- Advanced Operational Amplifiers (OpAmps): Exploring different types of singleended and fully differential OpAmps, common-mode feedback techniques, and the design flow of advanced operational amplifiers.
- Switched-Capacitor Circuits: Introducing switched-capacitor (SC) circuits, focusing on their fundamental principles and applications in analog-to-digital converters (ADCs) and digital-to-analog converters (DACs), covering sampling switches, SC amplifiers with various topologies, and SC integrators.
- Digital–Analog and Analog–Digital Converters (DACs and ADCs): Exploring the fundamentals of analog-to-digital and digital-to-analog conversion, their components, design, performance enhancements, and classification, focusing on CMOS-compatible implementations.
- Reference Generators: Covering the design of reference generators in CMOS technology, including supply- and temperature-independent references, offset voltage effects, and constant-Gm biasing, with an example of a state-of-the-art bandgap reference.
- Nanometer Design Studies: Exploring the impact of nanometer-scale device imperfections on circuit design and covers techniques for optimizing transistors and developing efficient, high-speed amplifiers.
- Layout and Packaging: Exploring the principles of layout and packaging in analog and mixed-signal CMOS circuits.

Teaching and working methods

This course comprises lectures, tutorials, laboratory exercises, and a project. The course includes tutorials that offer a detailed analysis of selected problem examples. Laboratory exercises provide hands-on experience in circuit design, simulation, and performance assessment using advanced CAD tools and industry-standard CMOS process technology models and parameters. Additionally, the course project enables students to integrate theoretical concepts from lectures and tutorials with the practical skills gained in lab sessions, applying them to a comprehensive design project.

Examination

TEN1	Written examination	2 credits	U, 3, 4, 5
LAB1	Laboratory work	2 credits	U, G
PRA1	Project Work	2 credits	U, G

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses

VLSI Design Project, Radio Frequency Integrated Circuits