Course syllabus

Analog IC-konstruktion
Analogue IC-design

ETIN25, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED E
Date of Decision: 2023-04-11

General Information

Main field: Electronic Design.
Compulsory for: MSOC1
Elective for: E4-fh, E4-is, F4, F4-fel, N4-hn
Language of instruction: The course will be given in English

Aim

Analogue IC Design builds upon the knowledge obtained in the course Analogue Circuits (ESS020 or ESSF01), or Modern Electronics (ETIN 70), where amplifier design using discrete components has been taught. In Analogue IC Design one will learn to design amplifiers on integrated circuits. The aim of the course is to create a solid understanding of analogue integrated circuit design. The focus is on CMOS technology, which is the most common technology for integrated circuits. The aim of the laboratory part of the course is to create skills using CAD-tools for IC-design, so that the students after completing the course can perform an IC-project (ETIN01) with analogue orientation.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- know how a CMOS circuit is built up, how the designer can control the shape of the circuit using the layout, and how different components such as transistors, diodes, resistors, and capacitors can be realized.
- be able to describe the behaviour of the MOS transistor and other components, for small signals as well as large. Furthermore be able to describe the function and characterizing properties of different building blocks designed using these

components. Examples of such building blocks are current mirrors, amplifier stages, and operational amplifiers.
- be able to describe how CAD-tools are used in the design of analogue integrated circuits.

Competences and skills
For a passing grade the student must

- Without computer: Be able to choose a suitable circuit topology for a given specification and to choose the parameters of the components involved such that the specification is met, and be able to analyse a given circuit regarding its function and performance. Furthermore be able to design and analyze the layout of components and calculate their desired parts as well as their parasitics.
- With computer: Be able to simulate analogue integrated circuits, design their layout, and verify the layout using CAD-tools.

Judgement and approach
For a passing grade the student must

- have achieved sufficient basic knowledge and learnt the most common terms, so that he/she can discuss ideas, problems and solutions with people active in the analogue IC design field.
- be able to judge if a design is suitable for integration on a CMOS chip or not.

Contents

The course starts with a short part about how CMOS circuits are manufactured, and how the designer can control the shape of the circuit using the layout. Then the realization of different components and their properties are covered. An emphasis is put on equations and models that describe the behaviour of the components, especially the MOS transistor. The components are then combined to different building blocks, primarily current mirrors, amplifier stages, and operational amplifiers. The choice of circuit topology and component parameters to meet a given specification is a very central part of the course, as well as analysis of given designs.

Modern CAD-tools for analogue IC-design is also an important part of the course, where the laboratory work is central. It covers design and simulation on schematic level as well as on layout level. After completed course one should be able to perform an IC-project (ETIN01) with analogue orientation. One can also continue with design of radio frequency CMOS circuits in Integrated Radio Electronics (ETI170).

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: The student must pass both the laborations part and the exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0118. **Name:** Written Exam.
Credits: 6. **Grading scale:** TH. **Assessment:** Approved Written exam
Code: 0218. **Name:** Laboratory Work.
Credits: 1,5. **Grading scale:** UG. **Assessment:** Approved Laboratory work

Admission

Assumed prior knowledge: ESS020/ESSF01 Analogue Circuits or ETE115/EITF90 Electromagnetics and Electronics or ETIA01 Electronics and FRT010/FRTF05 Automatic Control, Basic Course, or Modern Electronics ETIN70
The number of participants is limited to: No
The course overlaps following course/s: ETI063

Reading list

- Gray, Hurst, Lewis, Meyer: Analysis and Design of Analog Integrated Circuits, Fifth Edition. Wiley 2010.

Contact and other information

Course coordinator: Pietro Andreani, pietro.andreani@eit.lth.se
Course homepage: http://www.eit.lth.se/course/etin25