Analog/Digital System Design

Programme course

6 credits

Analog/digital systemkonstruktion

TNE026

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Offered for the last time
Spring semester 2022

Main field of study
Electrical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Electronics Design Engineering, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Analog circuits, Digital circuits, Signals and systems.

Intended learning outcomes

The course provides theoretical and practical depth in the development of digital/analog systems with the aid of advanced Electronic Design Automation (EDA) software. The course reinforces and further develops analog and digital circuit theory, while it also gives a practical introduction to design and fabrication of Integrated Circuits (ICs) using CMOS technologies. Techniques for analog and digital design are presented. Design of a functional integrated circuit from specification to verification and optimization will be completed in form of an industrial-like project and a professional project report. After passing the course the student should know:

- Explain the main steps of a CMOS process.
- Understand and compare the analog and digital models of CMOS transistors.
- Describe the relationships between physical and electrical characteristics of a MOS transistor and explain their effect on different transistor parameters, such as time delay, maximum frequency of operation, power consumption.
- Analyze and compare advanced analog ICs based on CMOS techniques, such as different types of current sources, amplifiers, filters and comparators.
- Analyze and compare simple digital circuits based on different CMOS techniques.
- Explain the process of designing complex analog/digital systems starting from simpler analog/digital circuits.
- Present project results in written form (technical report) and oral presentation.

Course content

CMOS transistor, from physical structure to electrical characteristics. Advanced analog ICs based on CMOS techniques, such as different types of current sources, amplifiers. Analog design techniques. Digital circuits based on different CMOS techniques. Combinational and sequential logic circuits. Digital design techniques. Mixed-signal circuits, such as comparators. Analog/digital systems design aspects. Design of Phase-Locked Loop (PLL) circuits and other PLL-based circuits. Using CAD tools for modelling of analog/digital systems. Different types of simulations. The design project relays on team building, project planning, pre-study, independent project work in the lab. Moreover, the design of an analog/digital circuit will include circuit schematic capture, development of own simulation set-ups, verification and optimization of all subcircuits and, finally, of the entire system.

Teaching and working methods

The course is organized around a project task and includes lectures, classes and laboratory sessions. They intensively support the necessary ICs design theory, the specific design methodology and the introduction of the new EDA-tool. The project will be carried out by groups of 3 students. The laboratory sessions will be dedicated to small parts of the project or to relevant project examples while introducing the EDA-tool and the ICs design methodology. The labs will be followed by lab reports including relevant theory, circuit schematics, simulation results and discussions around the applied design methodology with focus on circuit optimization.

Examination

UPG7	Written laboratory work	1 credits	U, G
PRA2	Well performed project with approved written report, presented in writing and orally	3 credits	U, G
UPG5	Short examination (dugga)	2 credits	U, G

The final grade is calculated from the results of the ingoing course submoments, examination (40%), project and laboratory (60%).

Grades

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

Other information

Supplementary courses: RF electronics, RF system design

Department

Institutionen för teknik och naturvetenskap

Director of Studies or equivalent

Adriana Serban

Examiner

Adriana Serban

Course website and other links

http://www2.itn.liu.se/utbildning/kurs/

Education components

Preliminary scheduled hours: 53 h
Recommended self-study hours: 107 h

Course literature

CMOS. Circuit Design, Layout, and Simulation, R. J. Baker, H. W. Li, D. E. Boyce, Wiley Interscience. ISBN 0-471-70055-X.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.