Course syllabus

Nanoelektronik
Nanoelectronics

EITP05, 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: Nanoscience.
Compulsory for: N4-hn
Elective for: E4-fh, F4, F4-nf, F4-fel, MNAV1, MSOC1
Language of instruction: The course will be given in English on demand

Aim

This course deals with the applications of nanoelectronics in a number of areas and it will give knowledge about how devices may be realized and modelled for applications both extending and beyond CMOS. For instance, the nanotechnology allows for an heterogeneous materials integration of transistors which may be used to reduce the power consumption in circuit applications and for programmable memories. The course will use knowledge in the areas of nanotechnology and circuit design (Modern electronics and High-speed Electonics). The use of nanowires and nanotubes will be discussed and different device technologies with potential to reduce the power consumption will be emphasized. Appliications within communication technology, radar, as well within the THz region will further be discussed. The course aims at providing a basis in how advanced materials science will generate new electronic applications.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to understand the limits of conventional technologies
- be able to describe the function for a set of nanodevices
- be able to describe where to use nanodevices

- be able to describe applications of nanoelectronics in communication technology and radar

Competences and skills
For a passing grade the student must

- be able to build a model for the device
- be able to design a simple circuit
- be able to examine the use of various nanodevices
- be able to develop nanodevices for communication technology and radar
- be able to write a scientific report in the form of a research article in IEEE format

Judgement and approach
For a passing grade the student must

- understand where nanoelectronics may contribute to the future development
- have experience of working in a research project
- realize the need for compromise between technology and application

Contents

Possibilities and challenges for the Si CMOS technology at and beyond the 20 nm node; FinFETs and NWFETs. Heterogeneous materials integration, High-k dielectrics, and ferroelectric materials. Tunneling devices and steep-slope transistors. Electronics based on III-V nanowires for high frequency applications (like 5G and THz), neuromorphic applications, and Quantum Technology.

During the laborations, the students will use models for nanoelectronic devices and during the project simulate how these perform in simple circuits. The use of conventional tools that the engineer later will use professionally will be emphazised.The design project will result in a writen student article in IEEE format.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam, laboratory work, project with oral presentation as well as written report in the form of a research article.

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.

Admission

Assumed prior knowledge: ETIN70 Modern Electronics or EITP01 High Speed Devices or corresponding
The number of participants is limited to: No
The course overlaps following course/s: FFF160

Reading list

- Lecture notes based on distributed articles.

Contact and other information

Course coordinator: Prof. Lars-Erik Wernersson, lars-erik.wernersson@eit.lth.se
Course homepage: http://www.eit.lth.se/course/eitp05