IH2653 Simulation of Semiconductor Devices 7.5 credits

Simulering av halvledarkomponenter

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

The official course syllabus is valid from the autumn semester 2024 in accordance with the decision from the director of first and second cycle education: J-2024-0526.Decision date: 2024-04-05

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

- Knowledge in semiconductor devices, 7,5 credits, corresponding to completed course IL2240/IH1611.
- Knowledge in numerical analysis, 6 credits, corresponding to completed course SF1512/SF1514/SF1544-SF1550.

- The upper secondary course English B/6.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After passing the course, the student shall be able to

- choose appropriate transport models and material parameters for physical simulation (TCAD) of advanced semiconductor devices such as FinFET and SOI
- use compact models for circuit simulation based on modern CMOS technology nodes and knowledge of power consumption, parameter extraction, fitting to measurement data and statistical methods such as corner simulations
- use mixed circuit and device simulations for example in the power electronics area with a focus on energy efficiency and sustainable energy production
- model discrete devices such as solar cells, light-emitting diodes and semiconductor-based sensors with a focus on energy efficiency and sustainable energy production
- use computer programs for multi-physics simulations for e.g. thermal effects in devices and circuits.

Course contents

The course covers modelling of semiconductors and nanostructures with numerical methods such as the finite difference method (FDM) and the finite element method (FEM) and industry standard simulation programs for circuit design. The focus is on modern CMOS technology nodes including FinFET, SOI and future generations of 3D devices. Power consumption, energy efficiency and sustainable energy production are recurring themes.

The following areas are covered:

- Description of comparative analysis of application and basic principles of physical device simulation (TCAD) and compact models for circuit simulation.
- Compact models for modern semiconductor technologies and their implementation by means of hardware descriptive languages in design software, including corner modelling and other statistical methods.
- General introduction to the combination of process simulation and device simulation for optimisation of future generations of semiconductor devices.
- Hierarchies for device, circuit and mixed device and circuit simulations and multi-physics simulations in the semiconductor and nanostructure areas.
- Thermal modelling, power consumption, variability and concepts such as ”dark silicon” in integrated circuits with 100-million transistors.
- Parallel programming and hardware support for demanding semiconductor simulations.

Examination

- TEN1 - Written exam, 7.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Transitional regulations

The module ANN1 is replaced by TEN1.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.