KTH Information and Communication Technology

IH2653/IH3610 Simulation of Semiconductor Devices Fall 2020

Course contents

- Basics of electromagnetism and its numerical analysis.
- Transport phenomena and their numerical analysis.
- Discretisation in one and multiple dimensions.
- Numerical solution of partial differential equations with the finite difference method, the finite element method and the finite volume method.
- Applications of numerical methods to semiconductor components and nanostructures.
- Kinetic transport models and Monte Carlo simulation.

Intended learning outcomes

Having passed the course, the student shall be able to

- implement numerical solutions of basic one- and multi-dimensional differential equation problems
- use computer programs for the solution of partial differential equations
- use computer programs for multi physics simulations
- choose the type of hardware that is appropriate for resource demanding numerical modelling
- assess the validity of simulation results through comparison with theory, measurements, or other simulations.

Staff involved

Lectures and examination: Assoc. Prof. B Gunnar Malm, EECS/EES, 08-790 4332, gunta@kth.se

Prerequisites

A basic course in semiconductor components or semiconductor physics and a course in electromagnetic field theory.

Literature

We will use a combination of lecture slides, lecture notes, book sections and program manual chapters.

Two text books are used and both are available for FREE download if you are logged in to KTH

1. Selberherr, "Analysis and Simulation of Semiconductor Devices", Springer (1984)

http://link.springer.com/book/10.1007/978-3-7091-8752-4

2. Saha, "Compact Models for Integrated Circuit Design -Conventional Transistors and Beyond"

https://www.taylorfrancis.com/books/9781315215181

Syllabus

- Basic numerical methods (repetition)
- Fundamentals of electromagnetism and its numerical analysis
- Transport phenomena and their numerical analysis, discretization in one and two dimensions
- The semiconductor equations
- Numerical solution of partial differential equations using the finite element method and the finite volume method
- Thermal and diffusion simulation
- Micromagnetic simulations
- Simulation on parallel computers and GPUs
- Numerical solution of partial differential equations using the finite element method and the finite volume method

Requirements

The examination is through homework assignments from the parts covered during lectures and labs. The course is worth 7.5 hp (higher education credits, equivalent to 7.5 ECTS).
IH2653: (Undergraduate course) Grading: A-F. Each person should hand in a set of individual solutions, including text, figures and software code. You may ask other students for help, but extensive help should be acknowledged in the report.
IH3610: (PhD course) Grading: pass/fail (75 points). PhD students should solve all problems individually.

Lectures and Tutorials

Lectures are according to the schedule. The lectures will also repeat material on solution of differential equations, numerical methods, electromagnetic field theory and semiconductor physics. Lecture notes and other material will be available on the website.

Homework

There are 8 sets of homework problems to be solved for a maximum of 100 points. Some homework requires the use of Matlab, Comsol Multiphysics or nanoHUB, see below.
Homework should submitted online in CANVAS.

Points	Grade
≥ 90	A
≥ 80	B
≥ 70	C
≥ 60	D
≥ 50	E
< 50	Fx