IH1611 Semiconductor Devices 7.5 credits

Halvledarkomponenter

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

Establishment

Grading scale

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

Education cycle

First cycle

Main field of study

Technology, Electrical Engineering

Specific prerequisites

Analog electronics, electrostatics and modern physics

Language of instruction

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

Intended learning outcomes

In detail, after a successful completion of the course you will be able to:

1. Qualitatively describe the electronic energy band structure of insulators, semiconductors and metals.
2. Calculate the electron and hole concentration in the conduction and valence band using Fermi-Dirac statistics and the energy band model.
3. Describe the constituents of the current density in semiconductors and derive analytical expressions for the current density in the case of low-level injection, electron-hole recombination, externally applied voltage and external generation by light, using the drift-diffusion model.
4. Describe the function of the pn-diode, the bipolar and the long channel MOS transistor.
5. Analyse and calculate the internal electrostatics (electric charge, electric field and potential) of the pn-diode, the bipolar and the long channel MOS transistor.
6. Derive and calculate the current density in the pn-diode, the bipolar and the long channel MOS transistor using the drift-diffusion model.
7. Describe major process technologies, used to fabricate semiconductor devices and relate these to schematic cross-section drawings of devices.
8. Extract device properties from electrical measurements of devices.
9. Perform oral and written presentation of the subject Semiconductor Components.

Course contents

The overall goal of the course is that you should be able to describe the function of devices, based on the pn-junctions and MOS-structures. These devices includes the bipolar and MOS transistors, and memory cells. You should be able to describe how these devices are used in applications. You should be able to derive and calculate the currents inside these devices and be able to analyse the internal state of the charge distribution, the electric field and the current density for given terminal bias voltages. You should be familiar with the process flow, used in the fabrication of modern microelectronics.

Course literature

Modern Semiconductor Devices for Integrated Circuits, Chenming Calvin Hu, Förlag Pearson, År 2010, ISBN-13: 978-0-13-700668-7
ISBN-10:0-13-700668-3

Examination

- SEMA - Seminar, 1.5 credits, grading scale: P, F
- TENA - Written Final Exam, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- LABA - Laboration, 1.5 credits, grading scale: P, 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.

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

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.