FIH3605 Power Semiconductor Devices 7.5 credits

Krafthalvledarkomponenter

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

Course syllabus for FIH3605 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Previous knowledge on semiconductor physics as well as the pn-junction, metal-semiconductor junction an MOS-gate structures is needed.

Language of instruction

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

Intended learning outcomes

The course deals with modern semiconductor devices used for controlling electric power in, for instance, motor drives and converter circuits. Today these devices are based on silicon technology, but devices in other materials are also discussed.

After completion of the course, the student will:

- know transport parameteters for different materials.
- understand how transport parameters, such as doping, lifetime and mobility, affect the flow of electrons and holes in devices.
- have an insight in what limits currents, voltages and switch times for devices, for instance breakdown mechanisms and temperature dependence.
- understand the design and function of typical uni- and bipolar devices, such as diodes, thyristors and IGBTs.
- have a good understanding of the losses in different devices.
- be able to select device types for specific circuit applications.
- be able to analyse and numerically estimate important device parameters, such as on-state voltage drop and avalanche breakdown voltage, from physical parameters.
- have a basic practical experience of measurements of device characteristics.
- possess sufficient knowledge to understand scientific articles about power semiconductor devices.

Course contents

Starting from physical material and transport properties, the course builds a solid understanding about how semiconductor power devices operate and how they are used to regulate electric power. Basic semiconductor physics and device theory will be breifely reviewed, although concepts that have a large impact on power devices will be more thouroughly covered, for instance avalanche breakdown and charge carrier lifetime. Both uni and bipolar device types are discussed, such as Schottky and pn-diodes, bipolar transistors, thyristors, MOSFET and IGBT. Focus is kept on understanding how physical properties can affect device performance and how lossed can be minimized at the same time as switching frequency, current-and voltage capabilities increase, by optimizing material properties and design.

Examination

- EXA1 - Examination, 7.5 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.

Pass/Fail

Other requirements for final grade

Presentation of individual project, participation in laboratory exercise, home assignments.

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.