SK2753 Nanoelectronics 9.0 credits

Nanoelektronik

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 SK2753 valid from Spring 2017

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics

Specific prerequisites

Basic understanding of the physics and chemistry of materials. Basic knowledge in solid state physics (Kittel) (SK2758) and of semiconductor physics and devices (IH1611).

Language of instruction

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

Intended learning outcomes

The goals of the course are:

- The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, heterostructures, carbon nanotubes, quantum dots, nanowires etc.
- The student should be able to set up and solve the Schrödinger equation for diferent types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.
- The student should be able to use matrix methods for solving transport problems such as tunneling, resonant tunneling and know the concept of quantized conductance.
- The student should be experimentally familiarized with AFM and PL methods and know their approximate performance as well as applications.
- Through the mini-project, students should get familiarized with searching for scientific information in their subject area, practice report writing and presenting their project in a seminar
- Finally, a goal is to familiarize students with the present research front in Nanooelectronics and to be able to critically assess future trends.

Course contents

The course reviews the trends in low dimensional semiconductors which use quantum phenomena to realize new functions or devices and new basic building blocks. These aim at electronic, opto-electronic and new bio applications. New approaches to nanoelectronic systems will also be overviewed.

Syllabus: Introduction, refresh in basic quantum mechanics and solid state physics, low-dimensional semiconductors, density of states, quantum wells and heterostructures, quantum wires, quantum dots, nanocrystals, optical properties, absorption, luminescence, transport including tunneling in low-dimensional semiconductors, single-electron devices, calculation methods, fabrication methods, analyses techniques, applications, new trends in silicon VLSI-technology, physical limits in nanoelectronics, nanoelectronic systems, new approaches to replace CMOS etc.

Course literature

The physics of low-dimensional semiconductors, John Davies, Cambridge Year: 1998, ISBN: 0-521-48491-X

Other lliterature Lecture notes, overview articles and laboratory instructions

Examination

- LAB1 - Laboratory Work, 1.5 credits, grading scale: P, F

- PRO1 - Project, 3.0 credits, grading scale: A, B, C, D, E, FX, F
- TEN1 - Examination, 4.5 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.

Other requirements for final grade

A written examination (TEN1; 4,5 credits) covers the lectured course.

To pass the course it is necessary to do the laboratory work (LAB1; 1,5 credits) and a project overviewing an application of nanoelectronics. This involves a written report and a seminar (ANN1; 3,0 credit).

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.