Faculty of Science

FYST39, Physics: Nanoelectronics, 7.5 credits

Fysik: Nanoelektronik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2009-10-07 to be valid from 2009-10-07, spring semester 2010.

General Information

The course is an elective course for second-cycle studies for a scientific candidate or Master's degree (120 credits) in physics.

Language of instruction: English and Swedish
If needed, the course is given in English.

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1F, Second cycle, has second-cycle course/s as entry requirements

Learning outcomes

The course intends to provide knowledge of applications of nanoelectronics within different fields and show how devices can be fabricated and modelled to be used as a continuation of the complementary metall-oxide-semiconductor technology (CMOS). Nano technology offers e.g. possibilities for heterogeneous materials integration of transistors which are used to minimise the energy consumption in circuits. The course builds both on courses in circuit design and in nanotechnology. The use of nanowires and nanotubes within electronics will be discussed in depth as well as different device concepts that have potential to minimise the power consumption.. Applications within communication technology will be presented.

Knowledge and understanding

To pass the course, the student should:

- be able to problematise the limitations of traditional technologies
- be able to describe the function of a number of nanodevices
- be able to explain where nanodevices can be used and
- know how nanodevices can be used in communication technology.

Skills and abilities

To pass the course, the student should:

- be able to build her/his own model for the device.
- be able to design a simple circuit solution
- be able to evaluate the use of different nanodevices and
- be able to develop nanodevices for communication technology.

Judgement and approach

To pass the course, the student should:

- understand how nanoelectronics can contribute to the continued development of electronics
- have experience of working in a research-oriented project and
- realise the need for compromise between technology and application.

Course content

- Possibilities and limitations of silicon-based CMOS scaled beyond the 20 nm node
- Heterogeneous materials integration: High-k dielectrics, epitaxy of strongly lattice mismatched materials combinations, nanowires
- Electronics based on nanowires and nanotubes and its RF- and noise properties
- Fundamental limitations for the switching energies in logic and quantum cellular automata (QCA).
- High speed circuits
- Power consumption in fundamental building blocks at high frequency.

At the laboratory sessions, the students will measure on nanodevices and develop models of nanoelectronic devices and simulate how these can be used in simple circuit solutions. Particular attention will be paid to the use of conventional simulation tools.

Course design

The teaching consists of lectures, group work and laboratory sessions. Participation in laboratory sessions and connected teaching is compulsory.

Assessment

Examination takes place in the form of a written examination at the end of the course. Students who do not pass the regular exam are offered a new possibility shortly after the regular exam.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, approved examination, approved laboratory reports and participation in all compulsory parts are required.
The final grade is determined by the written examination.

Entry requirements

For admission to the course, 90 credits natural sciences are required in which knowledge equivalent to FYSA31 Physics 3, Modern physics, 30 credits should be included and FYST15 Semiconductor physics, 7.5 credits or FYST34 High speed electronics, 7.5 credits should be included and English B.

Subcourses in FYST39, Physics: Nanoelectronics

Applies from V10

0901 Nanoelectronics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction