Faculty of Science

FYST34, Physics: High Speed Devices, 7.5 credits

Fysik: Höghastighetselektronik, 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: Swedish and English
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

Modern electronics such as mobile and satellite based communication systems are based on the design of high-speed devices. This course covers the fundamental design of the heterostructures in key components in both established and future technologies. It contains basic modelling of the DC and AC properties of heterostructure transistors but also specifically nanoelektronic examples such as tunnel diodes and ballistic devices. The lectures will build on a mathematical description of the transport properties of the devices, while currently used devices will be presented as examples.

Knowledge and understanding

On completion of the course, the student should:

- be able to describe how a transistor works
- be able to explain the design principles of HBTs and HFETs
- be able to calculate the performance of present devices
- be able to relate the performance to material properties
- be able to distinguish between ballistic and diffusive transport

Skills and abilities

To pass the course, the student should:

- be able to evaluate different technologies in terms of performance
- be able to design optimised devices
- be able to choose materials for a given device
- be able to use CAD-tools for simulation

Judgement and approach

To pass the course, the student should:

- understand the connection between materials properties and device performance
- realise the need for continued miniaturisation and development of alternative technologies
- have experience of to search information from research databases

Course content

- Heterostructures in semiconductor materials: materials properties and transport equations
- The heterostructure field effect transistor: basic and advanced models, physical properties
- DC and AC models of the transistor and parasites
- The heterostructure bipolar transistor: heterostructure design and base transport dynamics
- DC and AC models of the transistor and its parasites.
- Scaling theory for HBTs and HFETs
- Resonant tunnel diodes and ballistic FETs

Course design

The teaching consists of lectures, laboratory sessions, group work and project work. Participation in laboratory sessions and project work and thereby integrated other 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 and passed laboratory session and project reports and participation in all compulsory parts are required.
The final grade is decided 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 and FYST15 Semiconductor physics, 7.5 credits or FYSD13 Process- and component technology, 7.5 credits, and English B.

Subcourses in FYST34, Physics: High Speed Devices

Applies from H09

0901 High Speed Devices, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction