



LUND
UNIVERSITY

Faculty of Science

FYST24, The Physics of Low-dimensions, 7.5 credits
Fysik: Fysiken för låg-dimensionella system, 7,5 högskolepoäng
Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-06-14 to be valid from 2007-07-01, autumn semester 2007.

General Information

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

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

Main field of studies

Physics

Depth of study relative to the degree requirements

A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

Knowledge and understanding

On completion of the course, the student should be able to

- describe and explain physical phenomena in low-dimensional semiconductor heterostructures.
- calculate and explain basic electronic structure for realistic heterostructures by means of quantum mechanical models.
- calculate optical and electron transport phenomena of 0-, 1 and 2-dimensionella systems.
- describe applications of low dimensional structures in areas such as photonics and electronics.

Skills and abilities

On completion of the course, the student should be able to

- analyse advanced experiments and compare the results with realistic calculations.
- plan, carry out and evaluate an advanced research project.
- write well-structured reports that summarise, explain and analyse experimental and/or theoretical work.
- present own results in an oral talk.
- independently seek information beyond the reading list.
- choose approximations and models based on experience and knowledge in physics in a general sense.

The aim of the course

The course treats artificial materials with structures on the nanometer scale, where the movement of electrons is limited to two one or noll dimensions. The emphasis lies on heterostructures of semiconductor but also other low dimensional systems are discussed. Concepts and basic theory are introduced based on quantum mechanics and deepened by application on heterostructures. After the lecture part of the course is finished, the student carries out a project connected to the ongoing research during about 1.5 week. The research project is presented orally and in writing.

Course content

Concepts about heterostructures and resulting low dimensional systems, such as quantum wells, nanowires and quantum dots. Quantum physics applied to such systems. Optical properties of low dimensional systems (transition rules, polarisation etc). Electron transport properties of 2D and 1D system. Quantised conductance with Landauer-formalism. Scattering phenomena in 1D. Devices based on quantum phenomena and Coulomb blockade.

Course design

The teaching consists of lectures, calculation exercises, laboratory sessions and research projects. Participation in laboratory sessions and project work and other teaching integrated with that is compulsory.

Assessment

The examination consists of written laboratory reports, written and oral presentation of the project and written examination at the end of the course.

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, passed project work and participation in all compulsory parts are required.

The final grade is given by a weighted average of the included parts, with the

following weights: written examination 50%, laboratory reports 25%, project work 25%.

Entry requirements

For admission to the course is required:

English B and FYSA31 Physics 3: Modern Physics 30 credits, physics 3, or the equivalent.

Subcourses in FYST24, The Physics of Low-dimensions

Applies from H16

- 0711 Exam, 4,0 hp
Grading scale: Fail, Pass, Pass with distinction
- 0712 Project, 2,0 hp
Grading scale: Fail, Pass
- 0713 Laboratory Exercises, 1,5 hp
Grading scale: Fail, Pass

Applies from V08

- 0701 The Physics of Low-dimensions, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction