MH1016 Materials Physics 5.0 credits

Materialfysik

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for MH1016 valid from Spring 2009

Grading scale

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

Education cycle

First cycle

Main field of study

Technology

Specific prerequisites

5C1103/SG1130 Mechanics Foundation, 5B1115/SF1618 Mathematics I, 5B1116/SF1619 Mathematics II, 5A1227/SI1110 Physics II

Language of instruction

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

Intended learning outcomes

The overall objective is to provide an understanding of physical processes in solid materials and that materials physics is multi disciplinary and requires a considerable breadth of knowledge. We are dealing with electrical and electromagnetic properties of ´ traditional ´ crystalline materials with translation symmetry, but also polymeric materials and how properties depend on the dimension and structure (nanoparticles, thin layers). We relate all problems and reasoning to practical applications and measurements.

The labs provide practical experience with instruments and measurement methods and insights into a real research issue. The labs also include writing a report, which must meet the high demands on the context, circumstances, aesthetics, etc; that is, they must look like a scientific article.

After having completed the course the student will

- understand what kind of result an amorphous solid or glassy structure gives by X-ray diffraction
- to derive and understand Drude and Hall effect model and band theory
- to be able to do calculations on the skin effect and plasma frequency
- to make simple calculations of quantum mechanics
- to describe measurement principles such as scanning tunneling microscope and atomic force microscope
- be able to derive basic aspects of the optical properties of materials
- be able to categorize materials from aspects of band structure
- know some concepts of semiconductor such as band gap, intrinsic, extrinsic, donar and acceptor doping
- be able to calculate temperature dependencies, doping and conductivity in semiconductors
- understand the phenomena dia, para-and ferromagnetism and curie temperature
- be able to make simple calculations on measurements of saturation magnetization and susceptibility for paramagnets
- be able to deal with the demagnetization factor for simple cases demagnetiseringsfaktor
- be able to discuss superconductivity and the distinction between type 1 and type II
- be able to calculate on basic measurements for characterization of superconductivity
- be able to write a report and orally present the work done

Course contents

Electron theory (Drude, Sommerfeld, band), optical properties, insulators, piezoelectric materials, ferroelektriska material, ferro-and paramagnetism, magnetometri, hard and soft magnetic materials (metal, glass), superparamagnetism, superconductors, some elementary quantum mechanical concepts, photoemission, phonons, metallic conductors, semiconductors.

Disposition

Lectures 40h
Exercises 20h
Experimental work 20h
approximately 10h reports writing

Course literature

´ Electronic properties of engineering materials ´ of James d. Livingston, Wiley, ISBN 0-471-31627-X

Laboratory instructions

Examination

- TEN1 - Examination, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 0.5 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.

If the course is discontinued, students may request to be examined during the following two academic years.

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.