



IM2691 Condensed Matter Physics 9.0 credits

Kondenserade materiens fysik

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

Establishment

Course syllabus for IM2691 valid from Autumn 2008

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics

Specific prerequisites

Promotion to third year. Should have followed the courses 2B1121 Quantum Mechanics and 2B1111 Applied Physics, Thermodynamics and Waves

Language of instruction

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

Intended learning outcomes

General information about the course: Condensed matter physics is the research area in which more research workers are occupied than in any other area of physics. The basis of the subject is that from considering the matter on an atomic level one should be able to predict the observable properties of materials. The course is necessary for profiting from the materials physics profile and also very helpful in understanding the electronics and photonics profiles within the Microelectronics programme. To get a passing grade the students are expected to • have surveyed different types of materials (metals, semiconductors, insulators) and phenomena (magnetism, superconductivity etc.) within condensed matter physics • be able to give an account of the microscopic structure of materials and how it is mirrored in macroscopic properties • be able to perform simple calculations within the framework of the treated theoretical models • have got experience of and insight into certain fundamental experimental methods used to study solid materials • be able to explain at a qualitative level the factors influencing the band structure of a substance and exemplify how these factors determine its transport and optical properties • be able to give examples of advanced materials and their properties and applications and get insight into current research at KTH For higher grades it will be judged, among other things, to which extent the students also • can explain the connection between the type of binding in a substance, its crystal structure and its electrical conductivity • can apply fundamental statistical mechanics to determine certain thermal properties of metals and semiconductors • can relate the reciprocal lattice to the crystal structure and explain how it gives rise to entities like band structure and Brillouin zone • can show how the motion of electrons in crystals is influenced by electric and magnetic fields and by temperature • can illustrate how the function of important electronic components is derived from fundamental semiconductor properties • can describe and explain the background of different kinds of magnetism and the phenomena they give rise to • can give an account of the phenomenon of superconductivity and the difference between type I and type II superconductors and describe their applications

Course contents

Fundamental properties of condensed matter: Crystal structure, reciprocal lattice, defects, periodic wave functions, Fermi surfaces, free and nearly-free electron model, band structure, phonons, the Debye model. **Different materials and material properties:** Metals, insulators and semiconductors, magnetism, superconductivity, electrical and thermal transport properties, optical properties, low-dimensional structures. Possibility to enter deeply into some advanced material systems like semiconductor components, non-linear optical materials, photonic crystals, piezoelectric and ferroelectric materials, para-, dia-, ferro-, antiferro- and ferri-magnetic materials, magnetic multi-layers and memories, colossal magnetoresistance, spintronics, high-temperature superconductors, quantum wires and quantum dots, liquid crystals, quasi-crystals, fullerenes, polymers, organic semiconductors, bio-materials.

Course literature

Solid State Physics, J.R. Hook & H.E. Hall Upplaga: 2 Förlag: John Wiley & Sons År: 1991 ISBN: 0-471-92805-4 **Undervisningsspråk:** Svenska

Examination

- TEN1 - Examination, 6.0 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 3.0 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.

Other requirements for final grade

Written examination (TEN1; 6 credits) Fulfilled laboratory course (LAB1; 3 credits) Possibility to get bonus on the exam by midterms and in-depth task.

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.