SK2758 Solid State Physics 7.5 credits

Fasta tillståndets fysik

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

Establishment

The course syllabus is valid from Spring 2022 according to the school principal's decision: S-2022-0529 Decision date: 2022-02-24

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics

Specific prerequisites

Completed course SI1155 Theoretical physics or SH1012 Modern physics.

English B / English 6

Language of instruction

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

Intended learning outcomes

After the course, the student should be able to

- describe and classify materials from their crystal structure and atomic arrangements
- apply the theory for X-ray diffraction in reciprocal space (k-space) to determine the lattice structure of crystalline materials and also be able to use these principles for other waves in solid materials
- describe the different physical mechanisms for crystal binding by identifying repelling and attractive interaction coupled to atomic properties
- formulate basic models for lattice vibrations (phonons) and their influence on the physics of crystalline materials, make calculations based on these models and be able to relate the conclusions form the models to experimentally measured properties of materials
- formulate electron properties in a periodic potential, explain factors that affects the band structure of a crystalline material, make a simple band structure calculation and based on this develop a qualitative understanding of the band structure of materials
- explain the physical principles for different types of electric and magnetic phenomena in solid materials and relate this to macroscopically measurable quantities

with the aim of being able to handle the coupling between fundamental theoretical models and experimental results in solid state physics and having sufficient knowledge to continue with deeper studies within the field.

For higher grades, it is in addition required that the students should be able to apply the knowledge learnt in the course on for them completely unknown problems.

Course contents

The course introduces k-space (wave vector space) and the reciprocal lattice with its applications, which are central concepts for further studies within solid state physics. In addition, the course gives an overview of different models to describe the properties of solid materials. The syllabus is as follows

- Classification of solid material, atomic binding
- Crystalline materials, lattice vectors, unit cells
- Reciprocal space, Brillouin zones
- X-ray diffraction, Bragg's law, von Laue equations
- Lattice vibrations, phonons, heat capacity
- Free electron model, resistance in metals, Hall effect
- Band structure, Bloch wave functions, introduction to band structure calculations
- Semiconductors, metals, superconductivity and magnetism

Examination

- LAB1 - Laboratory Work, 1.5 credits, grading scale: P, F
- TEN2 - Written exam, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- TEN3 - Unsupervised examination, 1.5 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.

The examination TEN2 corresponds subject-wise to the earlier examination TEN1 in the course.

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.