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 autumn 2025 according to the decision of the head of undergraduate education: HS-2025-0165 Decision date: 2025-04-09

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 passing the course, students should be able to:

- Describe and classify materials based on their crystal structure and atomic arrangement.
- Apply the theory of X-ray scattering in reciprocal space (k-space) to determine the lattice structure of crystalline materials and utilize these principles for waves in periodic materials.
- Describe the various physical mechanisms of crystal bonding by identifying repulsive and attractive interactions linked to atomic properties.
- Formulate and use basic models for lattice vibrations (phonons) to make calculations and relate these models to experimentally measured properties of materials.
- Formulate the properties of electrons in a periodic potential and develop a qualitative understanding of the band structure with simple band structure calculations.

Explain the physical principles of different types of electrical and optical phenomena in solid materials and relate this to macroscopically measurable quantities.

Course contents

The course introduces k-space (wave vector space) and the reciprocal lattice and its applications, which are central concepts for further studies in solid-state physics. In addition, the course provides an overview of different models for describing the physical properties of solid materials.

The following subject content is included in the course:

- Classification of solid materials, atomic bonding
- Crystalline materials, lattice vectors, unit cells
- Reciprocal space, Brillouin zones 2025-04-09
- X-ray diffraction, Bragg's law, von Laue equations
- Semiconductors, metals, insulators
- Glitter vibrations, phonons, heat capacity, thermal conduction in semiconductors and insulators
- The free electron model, electrical and thermal conduction in metals, the Hall effect
- Band structure, Bloch wave functions, introduction to band structure calculations

Examination

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