



SK2771 Solid State Physics 5.0 credits

Fasta tillståndets fysik

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

Establishment

Course syllabus for SK2771 valid from Autumn 2018

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics

Specific prerequisites

Courses of the technology science block or equivalent; familiarity with basic quantum mechanics. In addition, for master-program students - basic requirements as specified for admission.

Language of instruction

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

Intended learning outcomes

This course gives an introduction to solid state physics with emphasis on properties of technologically important crystalline materials. The primary theme is to study the basic theory of structure, composition and physical properties of crystalline materials. At the end of the course, the students should be able to

- describe different types of crystal structures in terms of the crystal lattice and the basis of constituent atoms
- formulate the theory of X-ray diffraction in the reciprocal lattice (k -space) formalism and apply this knowledge to generalize the formulation for matter waves
- describe the different physical mechanisms involved in crystal binding identifying the repulsive and attractive interactions and correlate these with the atomic properties
- formulate the theory of lattice vibrations (phonons) and use that to determine thermal properties of solids
- formulate the problem of electrons in a periodic potential, examine its consequence on the band-structure of the solid and develop a framework that explains the physical properties of solids in terms of its band-structure
- apply the knowledge obtained to make a judicious choice of a solid in terms of its desired property
- identify the materials in a representative modern device/component, analyze why these materials are used
- recognize that the developed k -space formalism to describe phonons, electrons, is more general and can be used to describe waves in a periodic media and identify such 'out-of-the-course' physical situations/problems

Course contents

Condensed matter consists of a very large number of interacting entities and their physical properties, and these can be atoms, ions, electrons, spin etc. Studying this is essential to understand the properties of solids and thereby the design of electronic materials. The specific topics that will be covered are crystal structure, reciprocal lattice, crystal binding, lattice dynamics, theory of free electrons, distributions, energy bands, semiconductors, Fermi-surfaces, magnetism and superconductivity. At the beginning of the course, an overview of materials and components, and physical phenomena placing the course in context of modern technological developments will be given. Concerning the main topics of the course (listed above), we will follow the prescribed course book, Introduction to solid state physics by Charles Kittel, and lecture and tutorial materials. All the listed topics will be covered in detail except Magnetism and Superconductivity. These will be dealt extensively in other follow-up courses. During the course, we will also be emphasizing how a variety of physical phenomena can be understood by analyzing the problem in the so-called k -space (also referred to as wave-vector space, reciprocal lattice). You will be introduced to this powerful formalism and its application to understand diffraction of waves (e.g. X-rays, neutrons, electrons) by crystals, the properties of phonons (ref. lattice vibrations) and finally the behavior of electrons in a periodic potential.

Course literature

Introduction to Solid State Physics, Charles Kittel, Edition: 8, Publisher: John Wiley and Sons Inc. Year: 2005, ISBN: 0-471-68057-5

Lecture and tutorial materials

Examination

- TEN1 - Written examination, 5.0 credits, grading scale: A, B, C, D, E, FX, 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

Grade A-E on the written exam, 5.0 hp

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.