



Faculty of Health, Science and Technology
Physics
Syllabus

Course Approval

The syllabus was approved by the Faculty Board of Health, Science and Technology on 22 April 2013, and is valid from the Autumn semester of 2012 at Karlstad University.

Course Code: FYAE12

Solid state theory, 7.5 ECTS Credits

(Fasta tillståndets teori, 7.5 Swedish credit points)

Degree Level: Master

Progressive Specialisation: A1F (Second cycle, has second-cycle course/s as entry requirements)

Language of Instruction

English

Prerequisites

Physics 90 ECTS cr, including the courses Advanced quantum mechanics FYAD04, Solid state physics FYGC03 and Mathematical physics II FYGC02, or equivalent

Major Field of Study

FYA (Physics)

Learning Outcomes

Upon completion of the course, students should be able to:

- describe the most common lattice and crystal structures and their reciprocal lattices, symmetry operations, symmetry classification,
- describe and use the theory of scattering in crystals, describe common x-ray diffraction methods,
- demonstrate in-depth understanding of the basic theory of the electronic structure of crystals: the free electron model, electrons in a periodic potential, Bloch's theorem, electronic band structure and Fermi surfaces,
- give an account of the basic theory of multiparticle phenomena in the form of electron-electron interaction: Hartree-Fock theory, density functional theory,
- outline different methods for calculating electronic band structure, describe different types of crystal binding and crystal cohesion,
- demonstrate in-depth understanding of the classical theory of lattice vibration and the quantum mechanical theory of phonons,
- give an account of and use the semi-classical model of the motion of electrons in crystals influenced by electric and magnetic fields,
- demonstrate in-depth understanding of the properties of semi-conductors, band structure, doping, optical properties, describe applications in electronics: diodes, transistors,
- describe the theory of dia- and paramagnetism, demonstrate good understanding of the quantum mechanical theory of ferromagnetism,
- describe type I and type II superconductors, the microscopic theory of superconductivity.

Content and Form of Instruction

Instruction is in the form of lectures and seminars where the student present chosen parts of course literature or related material. The student chooses a subarea of course content for in-depth study and presents this orally and in writing. The topic of the specialisation must be approved by the examiner.

Course content:

- relevant concepts in solid state physics
- crystal structures and lattices; crystal symmetries, symmetry operations
- theory of scattering in crystals, reciprocal lattice, experimental methods of x-ray diffraction
- electronic structure of crystals, free electron model, electrons in a periodic potential, Bloch's theorem, Fermi surfaces, band structure, tight binding
- multiparticle phenomena; Hartree-Fock theory, density functional theory
- band structure calculation; crystal binding, cohesion energy
- lattice vibrations and phonons; classical theory and quantum theory
- the semi-classical model of electron dynamics, electron motion in static electric and magnetic fields, Boltzmann equation
- semiconductors; doping; diodes and transistors, optical properties
- diamagnetism and paramagnetism, quantum mechanical theory of ferromagnetism, Heisenberg model
- superconductivity.

Reading List

See separate document.

Examination

Assessment is based on written hand-in assignments and oral and written presentation of a specialisation assignment.

Grades

One of the grades Fail (U), Pass (G), or Distinction (VG) is awarded in the examination of the course. Engineering students are awarded one of the grades Fail (U), Pass (3), Some Distinction (4), or Distinction (5) in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course assessment is based on student views and experiences as reported in written course evaluations and/or group discussions. Students will be informed of the result of the evaluation and of the measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional Information

Students who enrolled before 1 July 2007 will complete their studies in accordance with the requirements of the earlier admission. Upon completion students may request degree and course certificates to be issued under the current ordinance if they meet its requirements.

The local regulations for studies at the Bachelor's and Master's levels at Karlstad University stipulate the obligations and rights of students and staff.

information@kau.se www.kau.se