



Faculty of Health, Science and Technology
Physics

Syllabus

Solid state theory

Course Code:	FYAE12
Course Title:	Solid state theory <i>Fasta tillståndets teori</i>
Credits:	7.5
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:
FYA (Physics)

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2016-03-15, and is valid from the Autumn semester 2016 at Karlstad University.

Prerequisites

Physics 60 ECTS cr, including the courses Solid State Physics 7.5 ECTS cr, Quantum Physics II 7.5 ECTS cr and Mathematical Physics II 7.5 ECTS cr, or equivalent

Learning Outcomes

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

- describe and use basic crystallographic concepts, demonstrate basic knowledge of symmetry operations in crystals and symmetry classification of crystals,
- describe and use the theory of x-ray scattering in crystals and describe common x-ray diffraction methods,
- describe and apply the basic theory of the electronic structure of crystals based on one-electron model: Bloch's theorem, electronic band structure and Fermi surfaces,
- give an account of and apply the basic theory of multiparticle phenomena in the form of electron-electron interaction: Hartree-Fock theory, and density functional theory,
- outline different methods for calculating electronic band structure,
- explain and 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, and give an account of quantisation effects in strong fields,
- describe and use central concepts in the theory of the optical properties of semiconductors and metals
- describe an use mean field theory and the quantum mechanical theory of dia- and paramagnetism, and ferromagnetism.

Content

Students advance their knowledge and skills in condensed matter physics. Instruction is in the form of lectures and seminars where the student present chosen parts of course literature or related material. The students choose 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:

- crystal structures and lattices; crystal symmetries, symmetry operations
- theory of x-ray scattering in crystals, reciprocal lattice, experimental methods of x-ray diffraction
- electronic structure of crystals based on one- electron model, Bloch's theorem, Fermi surfaces, band structure,
- multiparticle phenomena; Hartree-Fock theory, density functional theory
- band structure calculation; crystal binding, cohesive energy
- lattice vibrations and phonons; classical theory and quantum theory
- the semi-classical model of Bloch electron dynamics, quantisation of semi-classical dynamics, Fermi Liquid Theory
- optical properties of semiconductors and metals; dielectric function, optical transitions, excitons, plasmons
- mean field theory, quantum mechanic theory of diamagnetism, paramagnetism and ferromagnetism, the Heisenberg model, the Stoner model.

Reading List

See separate document.

Examination

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

Grades

Engineering students are awarded one of the grades U (Fail), 3 (Pass), 4 (Some Distinction), or 5 (Distinction) in the examination of the course. For other students, one of the grades U (Fail), G (Pass), or VG (Distinction) is awarded 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 evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional information

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