PHYS-310 **Solid state physics II**

Yazyev Oleg

Cursus	Sem.	Type
Physics	BA6	Obl.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

This course gives an introduction into Solid State Physics (crystal structure of materials, electronic and magnetic properties, thermal and electronic transport). The course material is at the level of Ashcroft & Mermin and is addressed to the 3rd year students in Physics.

Content

Electrons in periodic potential (cont.): tight-binding approximation, Fermi surfaces and band structures of selected elements.

Dynamics of electrons in periodic potential: semiclassical model, electrical conductivity, concept of hole charge carriers and effective mass, dynamics in presence of magnetic field.

Lattice vibrations and thermal properties: vibrational modes within harmonic approximation, phonons, specific heat, anharmonic effects, thermal expansion, heat conductivity.

Semiconductors: general properties and band structures, impurities, intrinsic and doped semiconductors, concept of hole charge carriers and effective mass, optical adsorption and excitons, p-n junctions, light-emitting diods, photovoltaic cells, transistors, elements of quantum confinement and quantum transport.

Magnetism: magnetic susceptibility, magnetic Hamiltonian of an isolated ion, ferromagnetism and antiferromagnetism, Heisenberg exchange interaction, mean-field theory, itinerant magnetism, magnetocrystalline anisotropy, magnetic domains and domain walls.

Superconductivity: history of discovery and classification, electric, magnetic and thermal phenomenology, London theory, elements of the BCS theory.

Learning Prerequisites

Required courses

Solid State Physics I

Learning Outcomes

By the end of the course, the student must be able to:

- Describe termal and vibrational properties of solids
- Compute band structures using the tight-binding approximation
- Compute trajectories in real and reciprocal space

- Characterize magnetism
- Characterize intrinsic and doped semiconductors
- Describe superconductivity

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.

Teaching methods

Ex cathedra and exercises in class

Assessment methods

Written exam in English or French

Resources

Bibliography

Lecture notes available on the Moodle webpage

- N.W. Ashcroft and N.D. Mermin, Solid State Physics, Holt Saunders Int. Ed. 1976, Physique des Solides, EDP-Sciences 2002

- Ch. Kittel, Physique de l'état solide, Dunod 2005

Ressources en bibliothèque

- Physique de l'état solide : cours et problèmes / Kittel Ch.
- Solid State Physics / Ashcroft N.W., Mermin N.D.

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=14394

Prerequisite for

Solid State Physics III, IV