UNIVERSITY OF PANNONIA

COURSE DATASHEET

Semester:	2014/15/1
Course:	Solid state physics
Code:	VEMKFI2212A
Responsible department:	Institute of Physics and Mechatronics
Department code:	MKFI
Responsible instructor:	dr. Péter Gurin

Course objectives:

Description of the macroscopic properties of the solid and condensed matter, and the understanding the underlying microphisical processes. Acquirement of the theoretical basis essential for the structural study and design of solid materials.

Course content:

1. Classical models for solid state matter: Drude's model. Electronic and heat transport, Hall effect, thermoelectric effect. 2. Sommerfeld's model. Teh weak point of the classical description, the importance of quantum effects. Quantum statistics. Thermodinamic properties of deal Fermi and Bose gases. 3. Crystal lattice. Types of lattices, symmetries. Bravais lattices.Reciprocial lattice, Brillouin zones. Dislocations. 4. Mechanical properties of the lattice. Deformation and stress tensor. Hooke's law. Plastic deformation. The role of the dislocation. 5. Elastic waves in a continuum. Wave equation and its solution. Ultrasonic study of the elastic properties. 6. Oscillation of a crystal, phonons. Osciallations of a one dimensional lattice. Acustic and optical branches. Interactions between electrons and phonons, Peierls transition. 7. Interaction of the lattice with radiation. Diffraction. Form factors. Study of the phonon spectrum by inelastic neutron scattering. Surface study methods: RBS. 8. Thermodynamic properties. Specipic heat of the lattice and the electron gas. Expansion. 9. Basics of quantum mechanics. Representation of observables by operators. Eigenfunctions and eigenvalues. Schrödinger's equation. 10. Spin in external field. NMR. Theory of covalent bounding. The hidrogene molecule. Metallic bounding. 11. Electrons in periodic potential. Kronig-Penny's model. Bloch's theorem. Energy bands. B and structure of metals, insulators and semiconductors. Electrons and holes, effictive mass. 12. Semiconductor materials and its applications. Intrinsic and doped semiconductors, diode, bipolar transistor, FET, IC. 13. Dielectric and optical properties of the matter. Polarization. Clausius-Mosotti relation.Frequency dependence of dielectric constant. Ferroelectric materials. Piesoelectonic effect. 14. Magnetism. Paramagnetism and diamagnetism. Ferromagnetism and its microscopic origin. Ising, Heisenberg, Stoner and Hubbard models. Spin glasses. Superparamagnetism. Study of the magnetic properies by neutron scattering. 15. Superconductivity. Meissner effect. Outline of the theory: Cooper's pairs, BCS theory. Josephson1s junction, SQUID. High Tc superconductors.

Requirements, evaluation and grading:

exam

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Required and recommended readings:

Charles Kittel: Bevezetés a szilárdtest fizikába. Muszaki Könykiadó (1965) Simonyi Károly: Elektronfizika. Tankönyvkiadó (1965) Aschroft-Mermin: Solid State Physics. Holt, Rinehart and Winston Inc. (1976)