VI: Condensed-matter physics

Free electron model of metals, Fermi energy and Fermi surface. Drude theory, conductivity and Hall effect (one carrier only).

Lattice vibrations: law of Dulong and Petit; phonons; dispersion relation with two atomic types: acoustic and optical branches; Einstein and Debye models of heat capacity.

Structure and types of condensed matter. Bonding of atoms: ionic, covalent, van der Waals, metallic *[Non examinable: hydrogen*]. Elasticity and thermal expansion.

Crystals. Bravais lattices, lattice planes, Miller indices and unit cells (conventional and primitive). Reciprocal lattice: Bragg and Laue formulation of diffraction; Brillouin zone; neutron and x-ray scattering.

Electrons in periodic potentials; tight binding model; band structure; Fermi surface; semiconductors and insulators. Semiconductors: Doping; law of mass action; direct and indirect band gap; concepts of holes and effective mass; mobility and Hall effect in semiconductor *[Non examinable: p-n junction, MOSFET]*.

Magnetism: Para- dia-, ferro-,antiferro-, and ferrimagnetism; application of Hund's rules to determination of magnetic ground states of isolated ions; Local Moment vs Itinerant magnetism. Mean field theory. Domains, domain motion, hysteresis.