VI: Condensed-matter physics

Structure and types of condensed matter: crystals, amorphous solids (glasses), liquids, liquid crystals. Bonding of atoms: ionic, covalent, van der Waals, *[non examinable: hydrogen, metallic]*.

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.

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

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 *[non examinable: protein crystallography]*. Elasticity, anharmonicity, and thermal expansion *[non examinable: phonon thermal conductivity]*.

Electrons in periodic potentials; tight binding model; band structure; Fermi surface; semiconductors and insulators. Semiconductors: effect of doping; law of mass action; direct and indirect band gap; concepts of holes and effective mass; mobility and Hall effect in semiconductor; MOSFET *[non examinable: memory chips]*.

Magnetism: para- dia-, ferro-, antiferro-, and ferrimagnetism. Mean-field treatment of phase transitions. Examples from magnetism and liquid crystals. Domains and domain motion; *[non examinable: Giant magnetoresistance: disk drives]*.