

Syllabus

(11-01-08) 3-1-08
 Midsem: 30 Att: 05
 Endsem: 55 Exam: 05
 Term: 05

Magnetism:

- Fundamental of magnetism: Magnetic terms and definition, classification of magnetic materials, magnetic moment, Bohr magneton, Bohr-van Leeuwen theorem, Magnetization
- Magnetization processes: Quantum theory of diamagnetism, paramagnetism, Ferromagnetism, ligand field and orbital moment quenching, Hund's rule, magnetism of interacting systems, Van Vleck
 Magnetization of a collection of independent ions, Curie law, Pauli paramagnetism, ions in a solid: crystal field, orbital quenching, JT effect
- Direct and indirect exchange interactions, Heisenberg exchange, Ising model, Mean field theory of FM, AFM, Ferrimagnetic systems, magnetic anisotropy and domain theory, Bloch wall and Neel wall, spin waves, magnons
 Super exchange int.; itinerant exchange Magnetic impurity RKKY int.
- Ferrites (normal and inverse spinel ferrites, Hexagonal ferrites, Magnetic thin film and multilayers, Magnetic sensors, Magnetic measurement systems (DC magnetometer, AC susceptibility)
- Magnetostriction, Magnetocaloric effect, Exchange bias effect
 Heisenberg model, AFM and the concept of frustration (Sh, CA, mlt, mag, Griffiths phase)
 Spintronics: GMR, TMR, AMR, spin dependent tunneling in magnetic tunnel junction, spin valves, spin polarized tunnelling, Magnetoresistive RAM, MTJ, spin diode, spin FET, spin injection and detection
 Mermin-Wagner theorem.
- Nanomagnetism: Single domain and multidomain, superparamagnetism
 Spin-Glass, cluster-glass, micromagnets, Griffiths-phases

Skyrmion, LLG eqn.

Superconductivity:

- Phenomenology of Superconductivity (Experimental results)
- Low and high T_c superconducting materials, type-I type-II superconductors, London-Pippard theory, penetration depth, Coherence length, electron-phonon interaction
- Electromagnetic properties of superconductors
- Thermodynamic properties of superconductors (sp. heat)
- Element of BCS theory and Ginzberg – Landau theory, energy gap, transition temperature, flux quantization, tunneling, d.c. and a.c. Josephson junctions tunneling effects, *Abrikosov Vortexes, superconducting granular, flux lattice*
- SQUID (superconducting quantum interferromagnetic devices)
- Applications of superconductors *Josephson effect, Superconducting junction, qubit & quantum chips, Novel Superconductors, Recent progress in SC, Search for R.T. SC.*