PH 503: CONDENSED MATTER PHYSICS II (3-1-0: 4)

Free Electron Fermi Gas

Energy level in one dimensions, Effect of temperature on the Fermi- Dirac distribution, Dirac Distribution, Free electron gas in 3D, Heat capacity of the electron gas, Electrical conductivity and Ohm's law, Motion in magnetic field, Thermal conductivity of metals.

Energy Bands

Nearly free electron model, Bloch function, Kronig- Penney Model, Wave equation of electron in a Periodic potential, Number of orbital in a Band.

Semiconductor

Formation of bands, Band gap, Intrinsic carrier concentration, Concept of a hole, Impurity conductivity, Fermi level, Direct and indirect band gap, P-N junction, Drift current, Diffusion current, Thermoelectric effects, Semimetals, Quantum nano structures.

Fermi Surfaces and Metals

Construction of Fermi surfaces, Electron orbit, hole orbit and open orbits, Calculation of energy bands, Experimental methods in Fermi surface studies.

Superconductivity

Experimental survey, Critical temperature, Meissner effect, Type I and type II superconductors, Thermodynamics of superconducting transition, London equation, London penetration depth, Energy gap, Basic ideas of BCS theory, High-TC superconductors. Applications of superconductivity in high energy physics, Electric power, Transportation, Medical application, Defense and space application.

Text Books & References:

1. C. Kittel, "Solid-State Physics", Wiley Eastern.
2. M. A. Wahab, "Solid State Physics: Structure and Properties of Materials," Alpha Science International.
3. D. A. Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill.
4. J. B. Ketterson and S. N. Song, "Superconductivity", Cambridge.
5. N. W. Ashcroft and N. D. Mermin, "Solid State Physics", Harcourt College Publishers.
6. S. M. Sze, "Physics of Semiconductor Devices", John-Wiley & Sons.