

# In.M.Sc. Applied Physics, 5 years

## 10<sup>TH</sup> SEMESTER

### FPYE-1004: CONDENSED MATTER PHYSICS-II

Mark-100

#### Unit-I

##### **Magnetism:**

Landau diamagnetism and Pauli paramagnetism, Weiss theory of ferromagnetism, Curie law for susceptibility, Heisenberg model- condition for ferro and anti ferromagnetic order, spin waves and magnons, Bloch  $T^{3/2}$  Law, Antiferro magnetic order, Neel temperature. Diluted magnetic Semiconductors.

##### **Ferroelectricity:**

Ferroelectric crystals, classification of Ferroelectric crystals, Polarisation catastrophe, Soft optical phonons, Landau theory of phase transition-second and first order transition, Multiferroics-Elementary concept

#### UNIT-II

##### **Electronic and lattice defects:**

Lattice defects, Frenkel and Schottky defects, Line defects, Edge and screw dislocations- Burger's Vector, Planar (stacking) Faults- twin planes and grain boundaries Color centers- mechanism of coloration of a solid, F-center, other color centers.

Excitons: Loosely bound, tightly bound, Excitonic Waves, Electron-hole droplets.

Exotic Solids

Amorphous materials, Quasi-crystals, Nano structured materials-Classification based on spatial extension (0-D, 1-D, 2-D). 0-D nanostructures-quantum dots, Widening of band gap in quantum dots, 1-D nano structures-Quantum wells-superlattices.

#### Unit-III

Electron-phonon interaction, Second quantized form of Hamiltonian for electrons and phonons interaction, electron-electron attractive interaction due to virtual phonon exchange, Cooper pairs and BCS Hamiltonian, Solution of BCS Hamiltonian- spin analog method.

Josephson effect: Microscopic quantum mechanical effect, Dc Josephson effect, Effect of electric field  $A_c$ /Inverse  $A_c$  Josephson effect, Effect of magnetic field, SQUID.

#### **Books:**

1. M. Tinkham: Group Theory and Quantum Mechanics
2. M. Sachs: Solid State Theory
3. A. O. E. Animalu: Intermediate Quantum Theory of Crystalline Solids
4. N. W. Ashcroft and N. D. Mermin: Solid State Physics

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5. J. M. Ziman: Principles of the Theory of Solids

6. C. Kittel: Introduction to Solid State Physics