

## PHYSICS-'35: SOLID STATE PHYSICS

**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor. (12 Lectures)

**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids.  $T^3$  law (10 Lectures)

**Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. (8 Lectures)

**Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeier relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes. (10 Lectures)

**Ferroelectric Properties of Materials:** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop (4 lectures)

**Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation) (6 Lectures)

### Reference Books:

- Introduction to Solid State Physics, Charles Kittel, 8<sup>th</sup> Ed., 2004, Wiley India Pvt. Ltd.
  - Elements of Solid State Physics, J.P. Srivastava, 2<sup>nd</sup> Ed., 2006, Prentice-Hall of India
  - Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
  - Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
  - Solid-state Physics, H.Ibach and H Luth, 2009, Springer
  - Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
  - Solid State Physics, M.A. Wahab, 2011, Narosa Publications
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## **PHYSICS PRACTICAL-VI**

*(Students have to perform at least 4 experiments from the section VIB. Additional experiments may be included with the approval of the committee of courses)*

### **PHYSICS LAB.-VIB**

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. Measurement various magnetic parameters of ferromagnetic substances, like coercivity, retentivity, saturation magnetization and hysteresis loss
4. To determine the Coupling Coefficient of a Piezoelectric crystal.
5. To measure the Dielectric Constant of a dielectric Materials with frequency
6. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
7. To determine the refractive index of a dielectric layer using SPR