

Solid State and Modern Physics

Course Code: BEB408

Contact Hours: 60

Credit: 04 (L-3, T-1, P-0)

MM: 100

Course Outline:

Solid State Physics

Crystal structure

Solids: amorphous and crystalline materials, lattice translation vectors, lattice with a basis-central and non-central elements, unit cell, reciprocal lattice, types of lattices, coordination number, miller indices, atomic packing fraction, separation between lattice planes, simple crystal structures of SC, BCC, FCC, diamond and HCP, brillouin zones, diffraction of x-rays by crystals, Bragg's law, Bragg's spectrometer.

Electrical properties of materials

Elementary band theory of solids, Bloch theorem, Kronig-penney model, Effective mass of electron, Concept of holes, Band gap, Energy band diagram and Classification of solids.

Magnetic properties of matter

Dia, para, ferri, ferro and anti-ferromagnetic materials, Classical Langevin theory of diamagnetism, Curie's law, Weiss's theory of ferromagnetism and ferromagnetic domains, B-H curve, Hysteresis and Energy loss.

Dielectric properties of materials

Polarization, Local electric field at an atom, Depolarization field, Dielectric constant, Electric susceptibility, Polarizability, Classical theory of electric polarizability, Clausius-Mosotti equation.

Superconductivity

Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, Temperature dependence of critical field, London's Equation and Penetration Depth, Idea of BCS theory (Qualitative), High temperature superconductors, Applications of Superconductors

Text Book:

1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.
2. A. J. Dekkar, Solid State Physics. Macmillan India Limited, 2000.

Reference Books:

1. Puri and Babbar, "Solid State Physics" (S. Chand)
2. J. S. Blackmore, Solid State Physics, Cambridge University Press, Cambridge.
3. N. W. Ascroft and N. D. Mermin, Solid State Physics, (Harcourt Asia, Singapore, 2003)
4. M. Ali Omar, Elementary Solid State Physics: principles and applications, (Pearson Education, 1999)

MODERN PHYSICS

Relativity

Frame of references, Inertial & non-inertial frames, Galilean transformations, Concept of ether, Michelson-Morley experiment, Postulates of the special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Mass-energy equivalence, Energy-momentum relation

Kinetic theory

Maxwell's distribution law for speed: average speed, rms speed, most probable speed, Maxwell's distribution law for velocity: average velocity, rms velocity, most probable velocity, Energy distribution of molecules, Temperature dependence, Degree of freedom and equipartition of energy, Mean free path

Radiation

Introduction to radiation, Properties of thermal radiation, Blackbody radiation, Kirchhoff's law, Energy density and pressure of diffused radiation, Stefan-Boltzmann law, Wien's displacement, Rayleigh-Jeans formula and Planck's radiation law

Laser

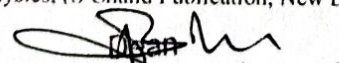
Concept of coherence, Absorption, Spontaneous emission and Stimulated emission processes, Relation between Einstein's A and B coefficients, Population inversion, Pumping, Main components of Laser, Principle of Laser action, Ruby Laser, He-Ne Laser, CO₂ Laser, Applications of Lasers

Text Books:


1. Arthur Beiser, Concepts of Modern Physics, TMH Publication, New Delhi, 2011

Reference Books:

1. H. S. Mani & G. K. Mehta, Modern Physics, East-West Press Pvt. Ltd
2. B. B. Laud, Lasers, New Age Publication, New Delhi
3. A. K. Ghatak, Physical Optics, Tata McGraw Hill
4. R. Murugesan, Modern Physics, (S Chand Publication, New Delhi, 2012).


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