MATERIAL SCIENCE

Course Objectives and desired Learning Outcomes:

1.Predict approximate physical and mechanical behavior of a material based on the type of bonding present (covalent, ionic, metallic, and/or van der Waals) and the presence of any of the several types of defects common in condensed matter.

2.Use knowledge of the crystal structure (BCC, FCC, and HCP) of a metal to make general predictions about the metalís ability to plastically deform.

3.Calculate the extent of diffusion-driven composition changes based upon composition, time, and temperature.

4.Predict the equilibrium microstructure of a material comprised of two constituents (e.g., Fe and C or Al and Cu) given the binary phase diagram and thermal history of the material.

5.Select materials for different applications based on the constraints of the given applications.

COURSE CONTENT

Atomic structure, molecules and general bonding principles, crystal system and structure , Miller indices, Bravais lattice, Bragg’s law, crystal structure for metallic elements, structural imperfections, dielectric parameters, polarsation, static dielectric constant of solids, ferroelectric materials, piezoelectricity, compex dielectric constant, dipolar relaxation, Debye equation , dielectric loss, insulating materials and their properties, composite materials

Magnetism: fundamental concepts pertaining to magnetic fields, magnetic dipole movement of current loops, orbital magnetic dipole movement and angular momentum of simple atomic model, classification of magnetic materials, spin magnetic moment, paramagnetism, ferromagnetism, spontaneous magnetization and Curie-Weiss law, ferromagnetic domains, magnetic anisotropy, magnetostriction, antiferromagnetism, ferrites and its applications, magnetic resonance

Conductors: introduction, atomic interpretation of Ohm’s law, relaxation time, collision time, mean free path , electron scattering, resistivity of metals, Linde’s rule, Joule’s law, thermal conductivity of metals, high conductivity materials, high resistivity materials, solder and electrical contact materials, carbon brushes, fuses, superconductivity-The free electron model, thermodynamics and properties of superconductors, meissner effect, classification of superconductors

Semiconductors: chemical bonds in Ge and Si, carrier density, extrinsic semiconductor, n-type , p-type semiconductor, Hall effect, mechanism of current flow, drift current, diffusion current, Einstein relation, materials for fabrication of semiconductor devices, fabrication technology , continuity equation, capacitance of junction barrier, junction transistors, thermistor, variastors Optical properties of materials: introduction, electromagnetic radiation spectrum, refractive index, reflection, Birefringence, Translucency, colourcentres, dispersion, absorption, excitons, photoelectric emission, electroluminescence , photoconductivity, photoelectric cells, lasers, ruby lasers, Nd-YAG laser, carbon dioxide laser, optical fibres, fibre materials, mechanism of refractive index variations, fabrication of fibre, fibre cables, solar cell, fuel cell, MHD generators.

TEXT BOOKS:-

1.Banerjee-Electrical & Electronics Material ,PHI.
2.S. O. Kasap- Principle of Electronics Material &Device,TMH.
3.Jones- Material Science for Electrical & Electronics Engineering , Oxford.
4.V.Raghvan Material science & engineering, PHI.

REFERENCE:-

1.J.Allison Electronics Engineering, Material &Device,TMH.
2.Gilmore: Material Science, Cengage Learnings.
3.Gupta & Gupta Advance Electrical & Electronics Material,Wieley India.
4.James F.Shackelford-Introduction Material Science for Engineering Pearson.
5.V.Rajendran - Material science,TMH.