PLPC2003 MATERIAL SCIENCE & ENGINEERING (3-0-0)

Course objective: The course aims to provide students with a comprehensive understanding of materials science principles, including structure, properties, processing, and selection criteria. Through theoretical learning and practical applications, students will develop the skills necessary for material characterization, processing, and engineering design in diverse industrial contexts.

Syllabus

Module - I (10 Hrs.)

Classification of Engineering Materials. Engineering properties of materials. Selection of Materials. electron theory of solids : Free electron theory of metals. Electrical conductivity; Thermal conductivity, quantum theory of free electrons. Band theory of solids, Conductivity of metals. Conductors, Insulators, Semiconductors, Intrinsic and extrinsic semiconductors, Band theory of semiconductors Hall effect. Super Conductors — Zero resistivity, Critical magnetic field and critical current density. Type I and II super conductors. Applications of Superconductors.

Module — II (08 Hrs.)

Dielectric Materials: Microscopic Displacement of atoms and molecules in an external dc electric field, Polarization and dielectric constant, Effect of frequency, Temperature dependence, Dielectric Breakdown. Ferro electric materials, Piezoelectrics, Pyroelectrics, Dielectric Materials as electrical insulators.

Module - III (10 Hrs.)

Magnetic Properties of Materials: Dia, Para and Ferro magenetic materials. Theory of magnetism, Ferro magnetic materials or Ferrites, Comparison of magnetic behaviour and magnetic parameters of Dia, Para and Ferro magnetic materials. Optical Properties of Materials: Scattering, Refraction, Theory of Refraction and absorption, Atomic Theory of optical properties. Lasers, Optical fibres —Principle, structure, application of optical fibre.

Module – IV (09 Hrs.)

Crystal structure of solids, lattice, Bravais lattices, unit cells, crystal structures, crystal planes and directions, co-ordination number. Single crystals, polycrystalline materials, nano crystalline materials. Imperfections in solids: point defects, line defects, surface defects. Solid solutions, phases, phase diagrams. Diffusion phenomenon, phase transformations.

Module – V (08 Hrs.)

Mechanical properties of materials: Stress and Strain, types of Stresses, Strain, Hooke's Law, rigidity modulus, bulk modulus, and Poisson's ratio, Stress-Strain behaviour of metals and nonmetals, brittle fracture and ductile fracture, simple shear stress and shear strain, Elastic constants, relationship between elastic constants (No derivation). Creep, fatigue.

Books:

1. Vijaya M. S., Rangarajan G, Materials Science, TMH
2. Introduction to Materials science for engineers by James. F.shackelford, Madanapalli.k. Muralidhara, Pearson (sixth edition)
3. Callister W.D., Materials Science and Engineering, John Wiley & Sons.
4. Smith, Materials Science & Engineering, Tata Mc. Graw Hill.
5. Van Vlack L. H., Elements of Material Science and Engineering, Addison Wesley
6. Raghavan , Material Science.
7. L.P.Singh, S.ubhash Chander, Rajesh K. Prasad, Materials Science and Engineering.

Course outcomes: After the completion of this course, students will be able

CO1	To understand the classification and engineering properties of materials, aiding in their selection for specific applications.
CO2	To comprehend the electronic structure of solids, including conductors, insulators, semiconductors, and superconductors, along with their practical applications
CO3	To analyze the dielectric properties of materials
CO3	To understand magnetic and optical properties of materials
CO4	To gain knowledge of crystal structures, defects in solids, phase diagrams, diffusion phenomena.
CO5	To understand mechanical properties of materials, including stress-strain behavior, elastic constants, fracture mechanics, and deformation mechanisms like creep and fatigue