



Engineering Physics – Mechanical Cluster

Course Code: 26ENXXXX

Semester: 1 and 2

Programs Offered: B. Tech (Mechanical and Aerospace Branches)

Course Type: Core

L – T – P – J: 3 – 0 – 2 – 0

Course Modules

Module - 1: Crystallography (8 hours)

Crystallography: Lattice, Unit cell, Lattice parameters, Crystal systems, Bravais lattices, Packing fraction for SC, BCC and FCC crystal systems. Introduction to Miller Indices, Determination of crystal structures using Miller Indices. Expression for Inter-planar distance (Qualitative), X-ray diffraction, Bragg's law (derivation) and Determination of Crystal structure by Powder method, Applications of XRD in science and technology, Defects in crystals, Numericals. [8 hours]

Module - 2: Thermal Properties of Solids (8 Hours)

Monoatomic and diatomic lattices, Lattice vibrations and normal modes, Acoustic and optical phonons, Phonons and phonon momentum, Density of states and dispersion relations, Specific heat of solids – Dulong–Petit law, Classical, Einstein and Debye models (Qualitative), Debye temperature, Thermal conductivity in solids, Lattice thermal resistance, Normal and Umklapp processes, Numericals. [8 hours]

Module - 3: Oscillations And Waves (10 Hours)

Simple harmonic motion (SHM), differential equation for SHM, Spring-mass systems, Free and damped oscillations, Quality factor, Forced oscillations (Qualitative) and resonance, Wave motion, Longitudinal and transverse waves, Standing waves, Ultrasonic waves and applications, Shock waves, Mach number, Properties of shock waves, Numericals. [10 hours]



Module - 4: Modern Physics (13 Hours)

Semiconductor Physics: Classification of Solids, Band structure, Fermi level in intrinsic and extrinsic semiconductors, Fermi-Dirac distribution function, Intrinsic carrier concentration (Qualitative), Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, Numericals. [6 hours] **Semiconductor Devices:** Zener diode: breakdown mechanisms and applications, Light Emitting Diode (LED): working principle and characteristics. [3 hours]

Nano Science: Nanomaterials and their classification, size-dependent properties and quantum confinement, nanocomposites and materials selection criteria, top-down and bottom-up synthesis approaches, applications of nanomaterials in engineering. [4 hours]

Module - 5: Physics for Robotics & Physical AI (6 Hours)

Rigid body dynamics: Foundations (rigid body definition, translational motion, rotational motion, degrees of freedom, torque, angular acceleration, angular momentum, rotational equilibrium), Coordinate Frames and Transformation, Rotational dynamics and inertia, Kinematics, Contacts, Friction and collision. [6 hours]

List of Experiments

No.	Experiment	Module Link
1	I-V Characteristics of Zener Diode	Module IV
2	Four Probe Technique -Resistivity measurement	Module IV
3	Dielectric Constant Determination	Module IV
4	Determination of the moment of inertia of a circular disc using a torsional pendulum	Module III
5	Band Gap Energy of an Intrinsic Semiconductor	Module IV
6	Planck's Constant using LED	Module IV
7	LCR Series and Parallel Resonance	Module IV
8	Transistor Characteristics (NPN-CE)	Module IV
9	Hall Effect - Concentration, Mobility and Conductivity	Module IV