

<b>XE-D</b>	<b>Solid Mechanics</b>
-------------	------------------------

Equivalent force systems; free-body diagrams; equilibrium equations; analysis of determinate trusses and frames; friction; particle kinematics and dynamics; dynamics of rigid bodies under planar motion; law of conservation of energy; law of conservation of momentum.

Stresses and strains; principal stresses and strains; Mohr's circle for plane stress and plane strain; generalized Hooke's Law; elastic constants; thermal stresses; theories of failure.

Axial, shear and bending moment diagrams; axial, shear and bending stresses; combined stresses; deflection (for symmetric bending); torsion in circular shafts; thin walled pressure vessels; energy methods (Castigliano's Theorems); Euler buckling.

Free vibration of single degree of freedom systems.

<b>XE-B</b>	<b>Fluid Mechanics</b>
-------------	------------------------

Flow and Fluid Properties; Newtonian fluid;

Hydrostatics; forces on submerged bodies;

Kinematics; Differential equations for mass and momentum balance for incompressible flows; Navier-Stokes equations; exact solutions (Couette & Poiseuille);

Inviscid flows; Euler Equations; Stream and Potential functions; elementary flows; flow past a cylinder with and without circulation.

Dimensional analysis & similitude.

Internal flows; Darcy-Weisbach Relation;

Laminar Boundary-layers; Flow Measurement (Orifice plat, Venturimeter; Pitot-Static tube).

### Section 1: Engineering Mathematics

**Linear Algebra:** Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

**Calculus:** Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

**Differential equations:** First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

**Complex variables:** Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

## Section 2: Applied Mechanics and Design

**Engineering Mechanics:** Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.

**Vibrations:** Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance;

## Section 3: Material Science

**Characterisation Techniques:** X-ray diffraction, Optical and Electron microscopy. **Structure and Imperfections:** Crystal symmetry, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals. **Thermodynamics and Kinetics:** Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusivity. **Properties of Materials:** **Mechanical Properties:** Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture. **Thermal Properties:** Specific heat, thermal conductivity and thermal expansion, **Material types:** Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, polymerization, structure and properties, additives for polymer products, processing and applications, effect of environment on materials, composites. **Environmental Degradation:** Corrosion, oxidation and prevention

## Engineering Drawing:

Basics of engineering drawing, sketching of Engineering objects and interpretation of drawings as a visualization and communication tool. Simple assembly and generation.