



## Syllabus for Written Test

1. Physical Metallurgy: Crystal structure and bonding characteristics of metals, ceramics, alloys and polymers, nano-crystalline and amorphous structures; solid solutions; phase transformation solidification; and binary phase diagrams; principles of heat treatment of steels, surface treatments, recrystallization, recovery, and grain growth; industrially important non-ferrous and ferrous alloys; elements of X-ray and electron diffraction; principles of scanning and transmission electron microscopy; polymers, composites and ceramics; electronic basis of thermal, electrical, optical and magnetic properties of materials; electronic and opto-electronic materials.
2. Mechanical Metallurgy: Defects in crystals; elements of dislocation theory - types of dislocations, twinning and slip, strengthening mechanisms; fatigue, tensile and creep behaviour; fracture - Griffith theory, super-plasticity; basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; Mechanical testing, compression, tension, torsion, hardness, creep, impact, fatigue, fracture formability and toughness.
3. Manufacturing Processes: Metal casting, Metal forming, Metal joining; NDT using dye-penetrant, ultrasonic, powder metallurgy; radiography, acoustic emission, eddy current and magnetic particle methods.
4. Mechanics of Solids: Concepts of stress and strain, state of stress at a point, Generalized Hooke's Law, Poisson's ratio, axial loading, torsion, flexure loading-shear force and bending moment diagrams, deflection of beams, stress and strain transformations, Mohr's circle of stresses and strains, principal stresses and strains, combined loading, Failure theories: Yield Criteria, Energy methods: Betti-Raleigh reciprocal theorem, Castigliano's theorem, principle of virtual work.
5. Basic understanding of Mathematics (Linear Algebra, Differential Equations and Vector Calculus) and logical reasoning.