



### 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:** Yield criteria, Elasticity and plasticity; 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) **Thermodynamics and Kinetics:** Thermodynamic systems and variables; *Laws of thermodynamics:* First, second and third laws, statistical interpretation of entropy. Free energy functions and criteria for equilibrium, Phase rule and binary phase diagrams, free energy composition diagrams, phase equilibrium calculations, *Chemical reactions:* reaction equilibrium, equilibrium constant
- (4) **Manufacturing Processes:** Metal casting, Metal forming, Metal joining; NDT using dye-penetrant, ultrasonic, powder metallurgy; radiography, acoustic emission, eddy current and magnetic particle methods.
- (5) Basic understanding of Mathematics and logical reasoning.