

METALLURGY AND MATERIALS SCIENCE

UNIT I - STRUCTURE OF METALS AND CONSTITUTION OF ALLOYS

Crystallography - Introduction, Ionic or electrovalent bond, Covalent bond, Metallic bond, Properties of metallic bond, Classification of Solids, Simple Definition, Crystallography, Crystal structure, Unit cell, Lattice parameters, Bravais Lattice and Basis, Crystal systems. **Miller Indices** – Introduction, Procedure or Step for finding Miller Indices, Directions and planes in a crystal, Inter Planar Spacing of Orthogonal Crystal Systems. **Space Lattice** - Simple cubic and its packing factor, Body center cubic structure (BCC) and its packing factor, Face center cubic structure (FCC) and its packing factor, Hexagonal Closed Packed Structure (HCP) and its packing factor. **Grain and Grain Boundaries** - Grain size, Inherently fine and coarse grained steel, Formation of grains by dendritic growth, Effect of cooling on grain formation, Effect of grain size on mechanical properties, Measurement of grain size, Carburising method, ASTM comparative method, Problem, Heyn's Intercept Method, Problem, Jefferies Planimetric method, Problem. **Alloys** - Difference between Metals and Alloys, Necessity of Alloying. **Solid Solutions** - Solid Solution vs Liquid Solution, Types of Solid Solutions, Substitutional Solid Solutions, Interstitial Solid Solutions, Factors Governing Solid Solubility, Possibilities of Solid Solutions.

UNIT II - PHASE DIAGRAMS

Phase Diagrams - Why should phase diagrams be studied, Information from phase diagram, Terminology used in phase diagrams, Types of equilibrium diagrams, Binary equilibrium diagram, Ternary equilibrium diagram, Classification of binary diagram, Types of binary phase diagram. **Isomorphous Alloy systems** - Isomorphous system, Construction of equilibrium diagram of isomorphous system, Construction of diagram, Cooling of an Alloy in Isomorphous System, Lever Rule, Example on phase diagrams, Coring. **Eutectic and Peritectic Systems** - Eutectic system, Examples of eutectic system, Phase diagram of eutectic system, Phase diagrams - Binary eutectic systems, Property variations in eutectic system, Properties of an eutectic alloy, Peritectic System. **Eutectoid and Peritectoid Systems** - Eutectoid Systems, Peritectoid systems, Monotectic system, Solidification of monotectic alloy, Types of monotectic alloys, Syntectic reaction, Equilibrium diagram of syntectic reaction, Phase rule, Gibbs phase rule, Application of phase rule.

UNIT III - STEELS

Allotropy - Introduction, Allotropy, Allotropic forms of Pure iron, Critical Points. **Iron carbon Equilibrium diagram** – Introduction, Iron-carbon equilibrium diagram, Importance of Fe-C system, Characteristics of Fe-Fe₃C diagram, Iron carbon system, Eutectoid transformation, Eutectic transformation, Critical temperature lines. **Annealing** - Effect of Alloying Elements on Fe-Fe₃C diagram, Annealing, Various types of Annealing, Full Annealing, Isothermal Annealing, Diffusion Annealing, Recrystallization Annealing, Process Annealing, Stress Relieving Annealing, Spheroidising Annealing. **Normalising** - Normalising vs Annealing, Mechanical properties of normalised and annealed steels. **Hardening** - Isothermal Transformation, TTT diagrams, Critical Cooling Rate, Factors Affecting the

Position of TTT curves. **Tempering** - Stages of Tempering, Effect of Tempering, Theory of Tempering. **Hardenability** - Introduction to Hardenability, Hardenability, Difference between Hardness and Hardenability, Jominy End Quench Test, Test Procedure, Quenching, Measurement of Hardenability, Factors affecting Hardenability, Uses of Jominy End Quench Test. **Alloy steels** - Alloying Steel, Effect of Alloying Elements, Effect of Alloying Elements, Classification of Alloy Steels, Molybdenum steel, Nickel Steel, Chromium Steel, Manganese Steel, Hadfield Manganese Steel.

UNIT IV - CAST IRONS, NON-FERROUS METALS AND ALLOYS

Introduction to Ferrous Metals - Introduction to Ferrous metals, Classification of Ferrous Materials, Cast Iron, Grey Cast Iron, White Cast Iron, Malleable Cast Iron. **Copper and its Alloys** - Copper, Uses of Copper, Properties of Copper Alloys, Brass, Bronzes. **Aluminium and its Alloys** - Non-Ferrous Metals, Classification of Non-Ferrous Alloy, Aluminium, Properties of Aluminium Alloy, Application of Al and Al-Alloys, Aluminium Alloys, Duralumin, Magnalumin, Al-Cu Phase diagram. **Titanium and its Alloy** - Titanium, Titanium Alloy.

UNIT V- CERAMICS, POLYMERS AND COMPOSITES

Ceramics- Ceramic materials, Classification of Ceramics, Advantages of ceramic materials, Applications of ceramics, Properties of ceramic materials, Electrical properties, Thermal properties, Chemical, optical and nuclear properties, Structure of crystalline ceramics, Silicate structures, Silicon-oxygen tetrahedron structure. **Glasses** - Glass, Structure of glass, Structure, Constituents of glass and their functions, Properties of glass, Mechanical properties, Electrical properties, Classification of glasses, Special types of glasses, Applications. **Cermet** - Cermet, Properties of cermets, Applications. **Composites** - Composite materials/Composites, Examples of composites, Classification, Particle reinforced composites, Reinforced Cement Concrete (R.C.C.), Dispersion-strengthened composites, Fibre-reinforced Composites, Structural Composites. **Polymers** - Introduction to polymers, Types of polymerization reactions, Addition or chain polymerization, Condensation or Step growth polymerization, Copolymerization.