# M.Tech. Written Exam Syllabus – Metallurgical & Materials Engineering
# M.Tech. – Materials Engineering

**1. Structure of Materials**
- Crystal structures: FCC, BCC, HCP
- Atomic packing, coordination number
- Miller indices and crystallographic planes
- Imperfections in solids: point, line, surface defects
- Diffusion: Fick's laws, mechanisms

**2. Thermodynamics & Phase Equilibria**
- Laws of thermodynamics
- Free energy, entropy, enthalpy
- Phase rule and phase diagrams
- Binary phase diagrams (isomorphous, eutectic, peritectic)
- Ellingham diagrams

**3. Phase Transformations**
- Nucleation (homogeneous & heterogeneous)
- Growth mechanisms
- TTT and CCT diagrams

**4. Mechanical Metallurgy**
- Stress-strain behavior
- Elasticity and plasticity
- Dislocation theory
- Strengthening mechanisms
- Fracture (ductile & brittle), fatigue, creep

**5. Physical Metallurgy**
- Iron-carbon diagram
- Heat treatment of steels
- Microstructures: pearlite, bainite, martensite
- Alloying effects

**6. Materials Characterization**
- X-ray diffraction (XRD)
- Optical microscopy
- Scanning Electron Microscopy (SEM)
- Basic spectroscopy concepts

**7. Extractive Metallurgy**
- Pyrometallurgy
- Hydrometallurgy
- Electrometallurgy
- Principles of ore beneficiation

**8. Engineering Materials**
- Metals and alloys
- Ceramics and glasses

- Polymers
- Composites
- Advanced materials (nanomaterials, biomaterials)

**09. Corrosion & Surface Engineering**

- Types of corrosion
- Electrochemical principles
- Prevention methods
- Coatings and surface modification

**10. Manufacturing & Processing**

- Casting and solidification
- Forming processes
- Welding/Joining of materials basics
- Powder metallurgy