

GATE SYLLABUS Part I - ENGINEERING SCIENCE (XE) Section-XE-C Materials Science





tutorialspoint

www.tutorialspoint.com





SECTION – XE-C: MATERIALS SCIENCE

Course Syllabus

Unit 1: Processing of Materials

- Powder synthesis
- Sintering
- > Chemical methods
- Crystal growth techniques
- Zone refining
- > Preparation of nanoparticles
- > Thin films

Unit 2: Characterisation Techniques

- > X-ray diffraction
- > spectroscopic techniques like UV-vis
- > IR, Raman
- Optical and Electron microscopy

Unit 3: Structure and Imperfections

- Crystal symmetry
- Point groups
- Space groups
- > Indices of planes
- Close packing in solids
- > Bonding in materials
- Coordination and radius ratio concepts
- Point defects
- Dislocations
- > Grain boundaries
- Surface energy
- > Equilibrium shapes of crystals

Unit 4: 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

Unit 5: 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
- Electronic Properties:
 - Free electron theory
 - Fermi energy
 - Density of states
 - Elements of band theory
 - Semiconductors
 - Hall effect
 - Dielectric behavior
 - Piezo
 - Ferro
 - Pyroelectric materials
- Magnetic Properties:
 - Origin of magnetism in metallic and ceramic materials
 - Paramagnetism
 - Diamagnetism
 - Ferro
 - Ferrimagnetism
- > Thermal Properties:
 - Specific heat
 - Thermal conductivity & thermal expansion
 - Thermoelectricity
- Optical Properties:
 - Refractive index, absorption and transmission of electromagnetic radiation in solids, electrooptic and magnetoopticmaterials
 - Spontaneous and stimulated emission
 - Gas and solid state lasers



Unit 6: 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

Unit 7: Environmental Degradation

- Corrosion
- Oxidation
- Prevention

Unit 8: Elements of Quantum Mechanics and Mathematics

- Basics of quantum mechanics
- Quantum mechanical treatment of electrical
- Optical and thermal properties of materials
- Analytical solid geometry
- Differentiation and integration
- Differential equations
- Vectors and tensors
- Matrices
- Fourier series
- Complex analysis
- Probability and statistics

