

### **Chapter one: Atomic Structure**

- Nature of Interatomic Bonding
- Structure of atoms
- Atomic mass units
- Electrons in Atoms
- Periodic Table
- Bonding Energies
- Types of Bonding

### **Chapter two: Crystal Structures**

- The Space Lattice and Unit Cells
- Crystal Systems and Bravais Lattice
- Principal Metallic Crystal Structures:
  - BCC Structure
  - FCC Structure
  - HCP Structure
- Atomic Packing Factor of BCC Structure
- Atomic Packing Factor of FCC Structure
- Atomic Packing Factor of HCP Structure
- Atom Positions in Cubic Unit Cells
- Miller Indices
- Planes and Directions
  - Planes and Directions in Cubic Unit Cells
  - Planes and Directions in Hexagonal Unit Cells
- Comparison of FCC and HCP crystals
- Planer Atomic Density

### **Chapter three: Imperfections in Solids**

- Point Defects
  - Vacancies and Self-interstitials
  - Impurities in Solid
  - Specification of composition
- Miscellaneous Imperfections

- Dislocation – Linear Defects
- Interfacial Defects
- Surface Defects
- Bulk or volume defects
- Atomic Vibrations

## **Chapter four: Mechanical Properties**

- Concepts of Stress and Strain
- Elastic LASTIC DEFORMATION
  - Stress-Strain Behavior
  - Anelasticity
  - Elastic Properties of Materials
- Plastic Deformation
  - Tensile Properties
    - Yielding and Yield Strength
    - Tensile Strength
    - Ductility
    - Resilience
    - Toughness
  - True Stress and Strain
  - Elastic Recovery after Plastic Deformation
  - Compressive, Shear, and Torsional Deformation
  - Hardness
- Failure
- Fracture
  - Fundamentals of Fracture
  - Ductile Fracture
  - Brittle Fracture
  - Principles of Fracture Mechanics
  - Impact Fracture Testing
- Fatigue
  - Cyclic Stresses
  - The  $S-N$  Curve
  - Crack Initiation and Propagation
  - Factors That Affect Fatigue Life

- Environmental Effects
- Creep
  - Generalized Creep Behavior
  - Stress and Temperature Effects
  - Data Extrapolation Methods
  - Alloys for High-Temperature Use

## **Chapter Five: Magnetic Properties**

- Basic Concepts
- Diamagnetism and Paramagnetism
- Ferromagnetism
- Antiferromagnetism and Ferrimagnetism
- The Influence of Temperature on
- Magnetic Behavior
  - Domains and Hysteresis
  - Magnetic Anisotropy
  - Soft Magnetic Materials
  - Hard Magnetic Materials
  - Magnetic Storage W44
  - Superconductivity

## **Chapter Six: Electrical Properties**

- Electrical Conduction
  - Ohm's Law
  - Electrical Conductivity
  - Electronic and Ionic Conduction
  - Energy Band Structures in Solids
  - Conduction in Terms of Band and Atomic Bonding Models
  - Electron Mobility
  - Electrical Resistivity of Metals
  - Electrical Characteristics of Commercial Alloys
- Semiconductivity
  - Intrinsic Semiconduction
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The Temperature Dependence of Carrier Concentration  
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The Hall Effect

- Electrical Conduction in Ionic Ceramics and Polymers
  - Conduction in Ionic Materials
  - Electrical Properties of Polymers
- Dielectric Behavior
  - Capacitance
  - Dielectric Strength
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## **Chapter Seven: Optical Properties**

- Basic Concepts
  - Electromagnetic Radiation
  - Light Interactions with Solids
  - Atomic and Electronic Interactions
- Optical Properties of Metals
- Optical Properties of Nonmetals
  - Refraction
  - Reflection
  - Absorption
  - Transmission
  - Color
  - Opacity and Translucency in Insulators

## **Chapter Eight: Electrical Superconductivity**