

16CH102 MATERIALS SCIENCE AND TECHNOLOGY



Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P	WA/RA	SSH/HSH	CS	SA	S	BS
45	15	-	8		60	-	10	-

Course Description and Objectives:

This course will emphasize the structure-property relationships of engineering materials. The objective of this course is to provide knowledge in basic principles of material science and also to study structure of materials at all length scales.

Course Outcomes:

The student will be able to:

- understand crystal structure of various materials and techniques used for structure determination.
- understand the influence of defects on the properties of materials
- understand the fundamentals of equilibrium phase diagrams.
- gain knowledge on various fabrication techniques used for manufacturing common engineering materials.

SKILLS:

- ü Identify the type of material: ceramic, polymer, metal or composite.
- ü Select materials with suitable properties for a given application.
- ü Predict the type of fracture/failure in a material.
- ü Read and draw conclusion from binary phase diagrams.
- ü Suggest manufacturing methods for metals, ceramics and polymeric materials.
- ü Determine basic mechanical properties of materials using universal testing machine.

UNIT - 1**L-09; T-03**

BONDING IN SOLIDS : Inter atomic forces and potential energy, Types of bonds - Primary and secondary; Variation in bonding character and resulting properties.

CRYSTAL STRUCTURE : Classification of crystal systems, SC, BCC, FCC and HCP crystal structures with examples, Atomic packing factor, Coordination number, Determination of miller indices of planes and directions of cubic and hexagonal crystals, Linear and planar densities, Separation between successive planes, Crystal structure determination - Bragg law, Powder method.

UNIT - 2**L-10; T-03**

CRYSTAL DEFECTS: Point defects, Dislocations - Edge, Screw and mixed; Burgers vectors, Energy of dislocation, Motion of dislocation, Dislocation density, Grain boundary, Stacking faults and twin boundary.

PHASE DIAGRAMS: Gibb's phase rule and terms involved, Reduced phase rule, Tie line and lever rules, Two component systems, Invariant reactions, Eutectic system and Iron-Carbon system.

UNIT - 3**L-09; T-03**

MATERIALS FABRICATION TECHNIQUES: Fabrication of Metals - Forming operations, Casting; Fabrication of Ceramics - Particulate forming processes, Cementation; Forming techniques of Plastics - Compression, Transfer and injection molding, Extrusion, Blow molding.

MECHANICAL PROPERTIES: Stress-Strain relations of various solids, Elastic, Anelastic, Visco-elastic and plastic deformations in solids, Creep and fatigue, Fracture - Brittle and Ductile, Fracture toughness, Ductile to brittle transitions.

UNIT - 4**L-08; T-03**

ELECTRICAL & SEMICONDUCTING PROPERTIES : Ohm's Law, Electrical conductivity, Electronic and Ionic conduction, Energy band structures in Solids, Classification of solids based on band models, Electron mobility, Electrical resistivity of metals, Intrinsic semiconduction, Extrinsic Semiconduction, The temperature dependence of carrier concentration, Factors that affect carrier mobility.

UNIT - 5**L-09; T-03**

DIELECTRIC AND MAGNETIC PROPERTIES : Dielectric behavior, Capacitance, Polarization, Frequency Dependence of dielectric constant, Dielectric strength, Types of magnetism, Ferromagnetism, Domain theory, Hysteresis behavior, Ferrimagnetism, Soft and hard magnets, Application of magnetic materials.

TEXT BOOKS:

1. W. D. Callister, "Materials Science and Engineering: An Introduction," 8th edition, John Wiley & Sons Inc, 2009.
2. V. Raghavan, "Materials Science and Engineering: A First Course", 5th edition, Prentice Hall of India Learning Pvt. Ltd., 2013.

REFERENCE BOOKS:

1. L. H. VanVlack, Elements of Materials Science and Engineering, 6th edition, Addison Wesley, 1989.
2. W.F. Smith and J. Hashemi, "Foundations of Materials Science and Engineering", 4th edition, McGraw-Hill, 2005.
3. N.W. Dowling, "Mechanical Behavior of Materials", 3rd edition, Prentice Hall of India, 2006.
4. J.F. Shackelford, Introduction to Materials Science for Engineers, 6th edition, Prentice Hall of India, 2004.
5. P. Haasen and B. L. Mordike, Physical Metallurgy, 3rd edition, Cambridge University Press, 1996.

ACTIVITIES:

- *Testing the type of failures.*
- *"Gee Whiz": Wonder presentations.*
- *Analysis of load test results.*
- *Study of micro structures of materials.*
- *Segregation of the given materials.*
- *Identification of phases in the given phase diagram.*

