

OBJECTIVE

To enable the students to have a basic knowledge about crystal systems, microstructure and dependence on various properties.

OUTCOME

On completion of the course the students are expected to

- Have learnt about the atomic structure and bonding.
- Have studied about the structure of solids and various imperfections.
- Have learnt the basics about phase diagrams and phase transformations.
- Have learnt the basic concepts of diffusion in solids.
- Have studied the general properties of the solids.

UNIT I CHARACTERIZATION OF CERAMIC SOLIDS

Classification of engineering materials – structure-property relationships – atomic structure – bonding – bond energy, bond type, bond length, ionic, metallic, covalent, vanderwaals, secondary, variation in bonding character and properties – polymorphic transformations – structure of ceramics – metallic and ceramic structures – binary, ternary, silicate structures.

UNIT II STRUCTURE OF SOLIDS AND IMPERFECTIONS

Crystalline and non crystalline states – inorganic solids – covalent, metals and alloys, ionic, polymers – classification – structure – crystallinity. Imperfections – point – vacancy, Schottky, Frenkel- Line – dislocations – edge, screw, properties of dislocations – surface - grain boundary, interface boundary, twin and twist boundary, stacking faults – volume imperfections.

UNIT III PHASE DIAGRAMS AND PHASE TRANSFORMATIONS

Phase rule – single component system – binary phase diagrams – micro structural changes during cooling – lever rule – applications of phase diagrams – phase transformations – time scale for phase changes – nucleation & growth – applications.

UNIT IV DIFFUSION

Fick's laws of Diffusion – Solution to Fick's second law – applications based on the second law solution. Relationship between diffusibility and atomic mobility. Atomistic mechanisms of Diffusion – vacancy , interstitial, substitutional, interstitialcy, ring mechanism. Different types of diffusivities and their interdependence – tracer diffusivity, chemical diffusivity etc. Temperature dependence of diffusivity and activation energy. Kirkendall effect and Matano interface. Surface and Volume diffusivity.

UNIT V PROPERTIES

Physical properties – density, specific gravity, melting behavior. Thermal Properties – heat capacity, thermal conductivity, thermal expansion. Dielectric properties – polarization, dielectric constant, dielectric strength, dielectric loss, capacitance.

TEXT BOOKS

1. V.Ragavan, Materials Science & Engineering, Prentice Hall of India, New Delhi, 2004.
2. W.D.Kingery, H.K.Bowen and D.R.Uhlmann, Introduction to Ceramics, John Wiley & Sons, 2nd Edn, 2004.

REFERENCES

1. David W Richerdson, Modern Ceramic Engineering, Marcel Dekker Inc, New York, 3rd Edn, 2006.
2. Michael W Barsoum, Fundamentals of Ceramics, McGraw Hill Co, New York. 2000.
3. Dr.M.Arumugam, Materials Science, Anuradha Agencies, 2002.
4. Upadyaya G.S and Anish Upadhyaya, Materials Science and Engineering, Viva Books Pvt. Ltd., 2006.