

**OBJECTIVE**

To enable the students to have a complete knowledge on the principle behind glass formation, raw materials and melting of glass batch, glass properties and quality control in glass.

**OUTCOME**

On completion of the course the students are expected to

- Have understood the principle behind glass formation and structures of different glasses.
- Have studied about the raw materials for glass making and calculation of a glass batch for a given composition.
- Have learnt about the reactions involved in the conversion of solid glass batch into a liquid glass melt.
- Have studied about the thermo-dynamical, thermal, mechanical, electrical and other properties of glass.
- Have learnt the defects found in a flat ware and a hollow ware, and the quality control procedure for a coated glass.

**UNIT I PRINCIPLES OF GLASS FORMATION**

Definition. Difference between a glass and crystalline material. Glass Formation – atomistic hypothesis of glass formation, kinetic approach to glass formation. Structures of glasses – fundamental laws, elements of structural models for glasses, structural models for silicate glasses. Phase diagrams of glass forming oxide systems – CaO-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub>, Na<sub>2</sub>O-CaO-SiO<sub>2</sub> etc.

**UNIT II RAW MATERIALS AND PREPARATION OF GLASS BATCH**

Raw materials – Glass formers, intermediates and modifiers, cullet, minor ingredients like oxidizing/reducing agents, refining agents, decolourisers, colouring oxides – description and importance. Selection of glass composition, change in properties in relation to change in composition, Glass batch calculation.

**UNIT III GLASS MELTING PROCESS**

Physiochemical reactions during glass melting – effect of particle size and pre-sintering on melting. Refining – sources of gas bubbles, identification of gases, solubility of gases in glass, growth & rise of bubbles, refining agents. Homogenization – sources of inhomogeneity, rate of homogenization in relation to diffusion kinetics, convection currents & rise of bubbles. Effect of colourants in glass melting.

**UNIT IV PROPERTIES OF GLASS**

Thermodynamic & thermal properties – density, surface tension, thermal expansion, specific heat, thermal conductivity. Mechanical properties – viscosity, elastic properties,

hardness, strength. Electrical & Transport properties – electrical conductivity, dielectric property, ionic diffusion. Other properties – refractive index, dispersion, chemical durability.

#### **UNIT V TESTING AND QUALITY CONTROL**

Flat glass defects – origin, characteristics. Container glass defects – origin, remedies. Test procedures for normal glass and coated glass.

#### **TEXT BOOKS**

1. James E. Shelby, Introduction to Glass Science & Technology, The Royal Society of Chemistry, 1997.
2. Paul, Chemistry of Glasses, 2<sup>nd</sup> Edn, Chapman & Hall, 1990.

#### **REFERENCES**

1. D. Ganguli, S. Kumar, Elements of Ceramics –Vol II, Indian Institute of Ceramics, 1984.
2. Fundamentals of Glass Manufacturing Process 1991, Proceedings of the First Conference of the European Society of Glass Science and Technology, Society of Glass Technology, 1991.
3. Tooley F.V, Handbook of Glass Manufacture, Vol I&II, Ogden Publishing Co., NY, 1960.
4. A. Charles A Harper, Handbook of Ceramic Glasses & Diamonds, McGraw Hill, 2001.
5. Glass Furnaces-Design, Construction & Operation, Wolfgang Trier, Society of Glass Technology, 2000.
6. Narottam P Banral, R.H. Doremus, Handbook of Glass Properties, Academic Press, Inc, 1986.