



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(CT)/SEM-5/CT-502/2011-12

2011

GLASS - I

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$$10 \times 1 = 10$$

i) Which of the following oxides is a good glass network former ?

a) K_2O

b) GeO_2

c) PbO

d) CaO .

ii) Which of the following glasses is not transparent ?

a) Alkali alumino silicate glass

b) Alkali borosilicate glass

c) Alkali-alkaline silicate glass

d) Chalcogenide glass.



- iii) Density of glass differs from true density due to
- a) bubbles present within the glass
 - b) solid particle inclusions with the glass melt
 - c) both (a) & (b)
 - d) none of these.
- iv) Good nucleating agent used in glass-ceramic is
- a) Cu
 - b) Si
 - c) Mg
 - d) Pb.
- v) With addition of alkali oxide to borate glass the density increases due to
- a) alkali ions occupy the interstitial position
 - b) co-ordination no. of B changes from 3 to 4
 - c) NBO is formed
 - d) none of these.
- vi) Ion exchange property in glass is taken place in
- a) changing the surface property of glass
 - b) refining of glass
 - c) annealing of glass
 - d) none of these.



vii) Thick slab cannot be obtained in

- | | |
|-------------------|-----------------------|
| a) Silicate glass | b) Chalcogenide glass |
| c) Metal glass | d) Phosphate glass. |

viii) Annealing of glass means

- dissolution of batch particle during melting
- strengthening of the surface of glass
- removal of strain from the shaped article
- removal of entrapped bubbles (air/gas) in the melt.

ix) The maximum thickness Y_c of the material transformed into a glass can be estimated using the formula

- $Y_c = \sqrt{D_{th} t_n}$
- $Y_c = \sqrt{\frac{D_{th}}{t_n}}$
- $Y_c = \sqrt{D_{th} T_n}$.

x) The free volume available in vitreous silica is

- | | |
|-----------|------|
| a) 29% b) | 27% |
| c) 21% d) | 17%. |



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

$3 \times 5 = 15$

2. Draw volume-temperature diagram for a glass forming liquid. Briefly describe the line moving into supercooled liquid along with glass transformation region (T_g) and fictive temperature (T_f). $1 \frac{1}{2} + 3 \frac{1}{2}$
3. The supercooled solid glass retains some of its features of the liquid state and as well as of solid state. Explain. Why metal glass can be obtained in tape or fibre form ? $3 + 2$
4. B_2O_3 is a good glass network former (GNF) but Na_2O is not. Explain with the help of different structural theories of glass formation in brief. $2 \frac{1}{2} + 2 \frac{1}{2}$
5. Briefly discuss the structure of phosphate glass. Why is phosphate glass less rigid than SiO_2 glass ? $3 \frac{1}{2} + 1 \frac{1}{2}$
6. a) Calculate average co-ordination number of boron in $20Na_2O \cdot 80B_2O_3$ (Mol %).
- b) Calculate average co-ordination number of 28G-12 Sb-60Se glass & compare the value with Se glass. $3 \frac{1}{2} + 1 \frac{1}{2}$



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. Discuss the structure of boron oxide glass. Explain the effect of alkali oxide and alkaline earth oxides on the viscosity and coefficient of thermal expansion of silicate glass. What is boron anomaly ? Explain the mechanism of this anomalous characteristic. Write the chemical composition of laboratory glassware. $4 + (2 \times 2) + 2 + 4 + 1$

8. Deduce the critical radius and the energy barrier for nucleation. Why heterogeneous nucleation is preferred to homogeneous nucleation ? Derive the modified Avrami Equation $\frac{V_t}{V} = \frac{\pi}{3} I_v \cdot u^3 \cdot t^4$.

 I_v = nucleation rate; u = growth rate; $\frac{V_t}{V}$ = fraction of total volume transformed. What is T-T-T diagram ? Locate the T_n & t_n and define critical cooling rate. $3 \frac{1}{2} + 2 \frac{1}{2} + 5 + 1 + 3$



9. Define density. Briefly describe the float & sink method and density gradient method for density measurement of glass.

Why is density of vitreous silica 2.20 gm/c.c., whereas that of coesite is 3.0 though both are composed of SiO_2 ?

Draw the effect of alkali oxide on the density of alkali silicate glass. Explain the anomalous behaviour of Na_2O and K_2O addition to alkali silica glass. Discuss the effect of thermal history and phase separation on density of glass.

$$1 + (2 \times 2 \frac{1}{2}) + 1 \frac{1}{2} + 2 \frac{1}{2} + (2 \times 2 \frac{1}{2})$$

10. Describe in short the measurement techniques of viscosity and thermal expansion coefficient of glass. Discuss the effect of composition and thermal history on viscosity and thermal expansion of glass. Define annealing point and Littleton's softening point of glass melt.

$$(2 \times 3) + (2 \times 3) + (2 \times 1 \frac{1}{2})$$



11. Write short notes on any *three* of the following : 3 × 5

- a) HMFG – preparation and application
- b) Preparation of silica glass by sol-gel method
- c) Mechanism of chemical durability of glass in aqueous solution and alkali solution.
- d) Structural theory of glass formation based on Sun's and Smekal's model theory.
- e) Structure of chalcogenide glass.

