Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(CT)(N)/SEM-5/CT-502/2012-13

2012

GLASS SCIENCE & TECHNOLOGY

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 oxide is not a glass network former ?

a) Na_2O b) P_2O_5

c) B_2O_3 d) GeO_2 .

ii) Free volume available in vitreous silica is

a) 28% b) 25%

c) 27% d) none of these.

iii) The Abbe No. is

a) $\frac{n_D - 2}{n_F - n_C}$ b) $\frac{1 - n_D}{n_F - n_C}$

c) $\frac{n_D - 1}{n_C - n_F}$ d) $\frac{n_D - 1}{n_F - n_C}$.

iv) Which one of the following is good refining agent ?

a) $CaCO_3$ b) $MgCO_3$

c) Na_2SO_4 d) Na_2CO_3.

v) Value of contact angle for favourable heterogeneous nucleation is

a) $\theta \leq 90°$ b) $\theta \leq 180°$

c) $\theta \geq 90°$ d) $\theta \geq 180°$.

vi) Fourier cosine transform is used in finding glass structure

a) Yes b) No.

vii) Metastable zone of undercooling appears in

a) I *vs* T plot b) u *vs* T plot

c) $\frac{dx}{dt}$ *vs* T plot d) none of these.

viii) Critical cooling rate $\left(\frac{dT}{dt}\right)_c$ is given by

a) $\frac{T_m - T_n}{t_n}$ b) $\frac{T_n - T_m}{T_m}$

c) $\frac{T_m - T_n}{T_n}$ d) none of these.

ix) To increase brilliancy in tableware which of the following oxides is added in glass batch ?

a) CaO b) Na_2O

c) PbO d) Al_2O_3.

x) According to Sun's structural theory which one is not a glass network former (GNF) ?

a) SiO_2 b) GeO_2

c) Se d) B_2O_3.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following $3 \times 5 = 15$

2. Give the modern definition of glass with proper examples. Metal glass is available in the form of tape or fibre not in thick slab. Why ? 2½ + 2½

3. Mention the basic principles of glass formation. Briefly describe any one with example. 2 + 3

4. What is Boron anomaly ? Determine the fraction of NBO and BO in the following glass :

   $25\,Na_2O\,.\,75\ SiO_2$ (mol %) glass. 2 + 3

5. Briefly discuss the Zachariasen's model of glass formation. Why MgO is not a glass former but SiO_2, B_2O_3 are glass former ? Justify with the help of this model. 2 + 3

6. Why ion exchange in glass is important technically ? Briefly describe the mechanism of chemical durability and Weatherability of glass. 1½ + 3½

GROUP – C

(Long Answer Type Questions)

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

7. Briefly discuss the nucleation rate in the kinetic theory of glass formation with thermodynamic deduction for critical radii for nucleation. Draw the nucleation rate (I) *vs.* temperature plot and explain the nature. Why heterogeneous nucleation is easier than homogeneous nucleation ? What is *T-T-T* diagram ? Locate the T_m & t_n and define critical cooling rate (CCR). 6 + 3 + 3 + 1 + 2

8. Define density. Briefly discuss the different measurement methods of glass density. Name the different factors that control the density of glass. Why density of $V.SiO_2$ is 2·20 g/c.c. whereas that of coesite is 3·0 g/c.c. 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 Li_2O & K_2O addition to alkali silicate glass.

1 + (2 × 3) + 1½ + 2 + 1½ + 3

9. Define refractivity and dispersion of light. Glasses based on BeF_2 have low R.I. (1·27) whereas V. SiO_2 and V. B_2O_3 have high R.I. (>1·458). Why ? Draw and explain the effect of different alkali oxides on the R.I. of glass. Discuss the mechanism of brown colour in amber glass. Define birefringence. Give the causes of birefringence in glass.

(1½ × 2) + 2 + 3 + 4 + 1 + 2

10. Explain the working principle of glass tank furnace. What are the chemical reactions taking place during melting of glass batch ? What factors to be considered during batch transportation. 6 + 6 + 3

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

a) Importance of *T-T-T* diagram in glass

b) Measurement technique & controlling parameter of coefficient of thermal expansion in glass

c) Significance of Temperature *vs.* Viscosity plot of soda-lime silica glass in commercial production

d) Structure of $Na_2O - SiO_2 - CaO$ & $B_2O_3 - Na_2O$ glass

e) Structural theory of glass formation based on Sun's & Smekal's model

f) Structure of chalcogenide glass.

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