Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH (CT)-(OLD)/SEM-1/M (CT)-102 (B/L)/2012-13

2012

CERAMIC SCIENCE

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 shows ferromagnetic behaviour ?

a) Si b) Ni

c) Mn d) Cr.

ii) Unit for surface energy is given by

a) kg/cm^2 b) $ergs/cm^2$

c) dynes/cm d) N/mm^2.

iii) Polytypism can be seen in the ..... ceramic.

a) Al_2O_3 b) SiC

c) Si_3N_4 d) TiC.

iv) Superconductors are perfect

a) Diamagnet b) Paramagnet

c) Ferromagnet d) Ferrimagnet.

v) Slip system of a *bcc* lattice can be

I. { 123 } [111]

II. { 112 } [111]

III. { 110 } [111]

a) only (I)

b) only (II)

c) all of these.

vi) Which should be the correct order of activation Energy (Q) for diffusion ?

a) $Q_{\text{surface}} > Q_{\text{grain boundary}} > Q_{\text{lattice}}$

b) $Q_{\text{surface}} < Q_{\text{grain boundary}} < Q_{\text{lattice}}$

c) $Q_{\text{surface}} > Q_{\text{grain boundary}} < Q_{\text{lattice}}$

d) $Q_{\text{surface}} < Q_{\text{grain boundary}} > Q_{\text{lattice}}$

vii) Fracture stress is proportional to

a) Crack length b) 1/crack length

c) $(\text{crack length})^{1/2}$ d) $(\text{crack length})^{-1/2}$.

viii) Driving force for recrystallization process is

a) grain boundary energy

b) stacking fault energy

c) stored energy for cold work

d) none of these.

ix) Diamagnetic susceptibility has the value

a) $+ 10^{-5}$ b) $- 10^{-5}$

c) $- 10^{5}$ d) $10^{-5} - 10^{-2}$

e) 10^{5}.

x) Schottky defect in ceramic material is

a) interstitial impurity

b) cotion anion vacancy pair

c) vacancy interstitial pair of cations

d) substitutional impurity.

GROUP – B

(Short Answer Type Questions)

Write short notes on any *three* of the following. $3 \times 5 = 15$

2. Spinel structure and normal & inverse spinel.
3. Frenkel and Schottky defects
4. Ferromagnetism and antiferromagnetism
5. Pauling's rules
6. Intrinsic and extrinsic semiconductors
7. Kröger-Vink notations.

GROUP – C

(Long Answer Type Questions)

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

8. Derive the pressure difference across a curved surface. Discuss wetting phenomenon. What do you understand by dihedral angle ? How do different values of dihedral angle determine the microstructure of a fired ceramic ware ? (Discuss with sketches.) $4 + 3\frac{1}{2} + 3\frac{1}{2} + 4$

9. Give an account of varieties of ceramic crystal structures based on specific close packing of ions such as *fcc* and *bcc*. What do you understand by 'polymorphism' and 'polytynism' ? 10 + 5

10. What do you understand by intrinsic ionic disorder ? Prove that the concentration of point defects is exponentially dependent on the formation free energy and on temperature. (Take any intrinsic point defect as your reference) 5 + 10

11. a) Discuss charge density in extrinsic semiconductors. Describe with sketch the effect of temperature on intrinsic and extrinsic semiconductors. 5 + 5

    b) Discuss ferromagnetism and ferrimagnetism with examples. 5

12. What are Fick's first and second laws of diffusion ? How do you consider diffusion to be a thermally activated process ? Describe random-walk diffusion process. 5 + 5 + 5

13. Write explanatory notes on any *three* of the following : 3 × 5

    a) Varistor and thermistor

    b) Ferroelectricity and piezoelectricity

    c) Primary and secondary recrystallization

    d) Slip and twinning mechanisms of plastic deformation

    e) Magnetocrystalline anisotropy and magnetostriction

    f) Mass transfer processes in solid state sintering.