



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. |

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[Turn over



- 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) $1/\text{crack length}$
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
- interstitial impurity
 - cation anion vacancy pair
 - vacancy interstitial pair of cations
 - substitutional impurity.

GROUP – B

(Short Answer Type Questions)

Write short notes on any *three* of the following.

$$3 \times 5 = 15$$

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

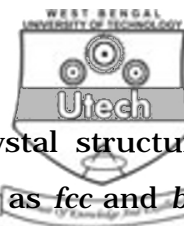
GROUP – C

(Long Answer Type Questions)

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

- 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.