Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CT)/SEM-7/CT-701/2009-10

2009

PHYSICAL CERAMICS

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) In α-alumina structure Al^{3+} ions exist in

      a) tetrahedral position

      b) octahedral position

      c) distributed in tetrahedral and octahedral positions

      d) none of these.

   ii) Bench mark model for liquid-state sintering was introduced by

      a) W.D. Kingery b) F.H. Narton

      c) Kuczynski d) none of them.

iii) Sintering aid used for alumina sintering to achieve theoretical density is

a) Na_2O b) TiO_2

c) Cr_2O_3 d) none of these.

iv) Major densification takes place during solid state sintering in its

a) initial stage b) intermediate stage

c) final stage d) none of these.

v) In volume diffusion material transport occurs from

a) neck region to surface region

b) grain boundary region to surface region

c) surface region to neck region

d) none of these.

vi) Which of the following is the most effective method of obtaining fine particle sizes for high degree of opacification ?

a) By having materials that are inert with glass phase

b) Having been crystallized from the melt during cooling/reheating

c) By having inert products formed during melting

d) None of these.

vii) For 'gem stones', it is desirable to have

a) low refraction and high reflectivity

b) strong refraction and high reflectivity

c) strong refraction and low reflectivity

d) none of these.

viii) Surface glass can be decreased by

a) using a high-index glass phase and creating surface roughness

b) using a low index glass phase and creating surface roughness

c) using a lead-base glaze or enamel composition

d) none of these.

ix) Up and down magnetic moments co-exist in

a) ferromagnetic crystals

b) ferrimagnetic crystals

c) paramagnetic crystals

d) all of these.

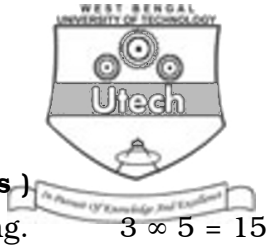
x) In diamagnetism, magnetic susceptibility can be

a) positive

b) negative

c) alternately positive or negative

d) none of these.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 ∞ 5 = 15

2. Discuss briefly how normal grain growth differs from abnormal grain growth.

3. Discuss briefly different changes taking place during solid state sintering.

4. Briefly describe normal and anomalous dispersion of light.

5. Discuss magnetic permeability and susceptibility.

6. Briefly discuss with sketches, dielectric polarization.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 ∞ 15 = 45

7. Define liquid state sintering. How does it differ from solid state sintering ? Discuss briefly how material transport occurs during liquid state sintering. Give a few examples of liquid state sintering. 2 + 4 + 6 + 3

8. Discuss briefly the effects of the following parameters on solid state sintering :

   a) Particle size and its distribution

   b) Sintering time

   c) Sintering temperature

   d) Sintering aids

   e) Sintering atmosphere.

9. a) Show schematically that ceramic dielectrics have best transmission in the optical part of the spectrum compared to metals and semiconductors. What are the reasons to increase of absorption at the *UV* and *IR* frequency regions for the dielectrics ?

   b) Define dispersion of light. Show the typical dispersion curve of an optical material. What is known as reciprocal relative dispersion ?

   c) State the important optical characteristics of opal glasses. State the primary methods to increase translucency of porcelains. Why does presence of porosity decrease translucency ?

d) A photon in a ZnS semiconductor drops from an impurity energy level at 1·38 eV belew its conduction band to its valence band. What is the wavelength of the radiation given off by the photon in the transition ? If visible, what is the colour of the radiation ?

(ZnS has an energy band gap of 3·54 eV.

$h = 6{\cdot}62 \times 10^{-34}$ J.s

$C = 3{\cdot}00 \times 10^{8}$ m/s

1 eV = $1{\cdot}60 \times 10^{-19}$ J) 3 + 3 + 6 + 3

10. a) "The properties of magnetic materials vary with direction." Justify this statement with suitable examples.

b) Define magnetostatic energy. How can the magneto-static energy of a ferromagnetic material sample be minimised ?

c) What are hard and soft magnetic materials ? Cite their characteristic features. Name at least two examples and briefly discuss the properties of each of them.

d) Define ferrimagnetism. Give an example of a ferrimagnetic compound. 3 + 4 + 6 + 2

11. a) What causes the electrical resistivity of a metal to increase as its temperature increases ?

b) Establish a quantitative expression for the conductivity of a semiconductor in terms of concentration of charge carries, mobility of charge carries and electronic charge.

c) Discuss the effect of temperature on electrical conductivity of intrinsic and extrinsic semiconductors with sketches.

d) The Fermi level of an intrinsic semiconductor lies near the middle of valence & conduction band but for *n*-type semiconductor it is nearer to the conduction band. Explain. 2 + 6 + 4 + 3