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CS/B.Tech (CT)/SEM-7/CT-701/2010-11

2010-11

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) Which of the following ceramics resembles Rock salt type crystal structure ?

   a) Sic b) ThO_2

   c) MgO d) $FeAl_2O_4$.

   ii) What is the total no. of atoms in an FCC structure ?

   a) 2 b) 3

   c) 4 d) 6.

   iii) Reflectivity of metals is

   a) 0·05 b) 0·50

   c) 0·95 d) None of these.

iv) Snell's law relates

a) light reflection b) light refraction

c) light transmission d) light absorption.

v) Sky looks blue because the sunlight is subjected to

a) Compton scatting b) Rayleigh scattering

c) Both (a) and (b) d) None of these.

vi) In sintering of alumina, the additive used to stop secondary grain growth is

a) Na_2O b) SiO_2

c) MgO d) None of these.

vii) In solid state sintering, major changes take place in

a) initial stage

b) intermediate stage

c) final stage

d) both in intermediate and initial stages.

viii) Diffusion can occur in

a) solid

b) liquid

c) gas

d) all of these.

ix) Example of paramagnetic materials are

a) superconductors

b) alkali metals

c) transition metals

d) rare earth metals.

x) In respect of magnetocrystallic anisotropy energy, the hard direction of magnetization is

a) < 100 > b) < 111 >

c) < 110 > d) < 010 >.

GROUP – B

(Short Answer Type Questions)

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

2. Define liquid phase sintering. How does it differ from vitrification ?

3. What are the basic differences between homogeneous nucleation and heterogeneous nucleation ?

4. Write a short note on spinel structure.

5. Discuss 'Normal' and 'Anomalous' dispersions of light.

6. Discuss 'Direct exchange' and 'Super exchange' interaction of outer electrons.

GROUP – C

(Long Answer Type Questions)

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

7. Write down the Fick's first law of diffusion. Derive Nernst-Einstein equation for diffusion. Discuss the effect of temperature on the diffusion coefficient. Write a short note on surface diffusion. 2 + 5 + 3 + 5

8. Name different mass transport mechanisms operating during solid state sintering. Discuss briefly two such types of masstransport mechanisms operating during ceramic solid oxide formation. Discuss briefly the role of sintering aids during solid state sintering. 3 + (4 × 2) + 4

9. a) What are the main contributing factors that affect the opacity of a two-phase system ? How do porosity and refracture index affect translucency of percolations and bone China wares ? 3 + 3

b) Compare sheet steel porcelain enamel, cast iron enamel and porcelain body glaze in respect of coating thickness, degree of opacification required and opacity to be used in each case. 4

c) State the important optical characteristics of an opal glass. State whether samples with high or low index of refraction are easy to observe microscopically. 2 + 1

d) State the Lambert's and Beer's laws as applied to absorption of light. 2

10. a) Discuss how you would classify materials in terms of 'Bond Theory of solids'. Give suitable sketches and band diagram is support of your answer. 7

b) Discuss why conductivity increases with temperature for a semiconductor while it decreases with temperature for a metal. 4

c) A wire of 0·5 cm diameter must carry a 40 A current.

i) If the maximum power dissipation along the wire is 0·04 W/cm, what is the minimum allowable electrical conductivity of the wire? (Give answer in SI unit)

ii) What is the current density in the wire ? 4

11. a) Discuss the influence of an applied magnetic field on the motion of electrons in their orbits and hence define 'diamagnetism' and 'diamagnetic susceptibility'.

b) What are magnetic domains ? Define spontaneous magnetization. Why are Fe, Co and Ni magnetic, while Mn and Cr are not even though all these elements have impaired 3*d* electron ?

c) What are paramagnetism, ferromagnetism, anti-ferromagnetism and ferrimagnetism ? Give examples. Define magnetic susceptibility and draw susceptibility temperature curves for dia, para, ferro, antiferro and ferrimagnetic materials. 2 + 1 + 1 + 2 + 4 + 5

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

a) Charge density in extrinsic semicondmetors.

b) Classification, applications and examples of ferrites

c) Magnetostatic energy and magnetocrystallic anisotropy energy.

d) Dielectric polarization and relaxation

e) Effect of temperature on intrinsic and extrinsic semiconductors.