

## B. MET. ENGG. FINAL EXAMINATION 2006

1st Semester

## MATERIALS SCIENCE

Time: Three hours

Full Marks: 100

Answer any five questions.

1. a) Define porosity. What are different types of porosity?  
Explain how does porosity influence other properties. 2+2+6
- b) Discuss the determination of bulk density. 10
2. a) State and explain the process involved at the molecular level for the formation of silica gel. 5
- b) Discuss the advantage and disadvantage of sol-gel process over the conventional process. 5
- c) Outline the method of synthesis of metal silica nanocomposites through sol-gel process. 10
3. a) State Pauling second rule. Show that this rule is based on electro-neutrality condition. 2+10
- b) Find the critical radius ratio for co-ordination number eight. 8

[Turn Over]

(2)

4. a) Define co-ordination number. Find the co-ordination number in F C. C. crystal. 1+2

b) Draw zinc blende structure. Compute the co-ordination number of anion. Explain the distribution of  $Zn^{2+}$  in the structure.

Given:  $\mu_{Zn^{2+}} = 0.75\text{\AA}$  and  $\mu_{S^{2-}} = 1.84\text{\AA}$ . 3+4+2

c) Discuss the spinel structure. What are the different types of spinel structure? Explain the origin of ferrimagnetism from the spinel structure. 2+1+5

5. a) Explain in details the temperature dependent phase transformation of fire clay and bentonite upto  $1000^{\circ}\text{C}$ . 12

b) Draw  $Al_2O_3$ - $SiO_2$  phase diagram. Label the phase fields. Superduty silica brick will have less  $Al_2O_3$  as impurity than conventional silica brick. Explain. 5+3

6. a) Explain the:

(i) representation of composition in a ternary system

(ii) representation of ternary eutectic system in a plane

(iii) computation of the relative amount of phases in a simple ternary system during the course of cooling from liquid to solid. 2+3+5

b) Explain the bloating phenomenon in a fire clay brick.

4

(3)

- c) Discuss the relative severity of CaO and FeO as slagging agents for fire clay brick. 6
7. a) State and explain the characteristics of different modes of phase transformation in SiO<sub>2</sub>. 5
- b) Explain in a tabular form the different polymorphic transformations of Silica. 5
- c) Explain the course of phase transformation of synthetically made 97.5% SiO<sub>2</sub>, 2% CaO and 0.5% Al<sub>2</sub>O<sub>3</sub> silica brick during the course of heating from room temperature to 1450°C. 10