

Code No: 07A71801

**R07****Set No. 2**

IV B.Tech I Semester Examinations, November 2010  
CERAMIC SCIENCE AND TECHNOLOGY  
Metallurgy And Material Technology

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
All Questions carry equal marks

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1. (a) With a neat sketch explain the crystal structure of diamond?  
(b) Describe monoclinic, triclinic and tetragonal crystal systems? [7+9]
2. (a) Classify ceramics?  
(b) Describe the properties and applications of structural ceramics? [8+8]
3. Explain the behavior of different ceramic compositions in the MgO-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> system with a neat sketch? [16]
4. Describe forming of ceramics by Extrusion. [16]
5. Explain how Si<sub>3</sub>N<sub>4</sub> is produced by sol-gel process. [16]
6. (a) Discuss about the Hot Isostatic pressing (HIP) equipment.  
(b) What are the Hot Isostatic Pressing (HIP) applications? [8+8]
7. Describe from polarization mechanisms which exist in a typical dielectric such as BaTiO<sub>3</sub>, at a temperature below the curie point. Draw a curve of dielectric constant and loss factor as a function of frequency from 10 to 10<sup>20</sup> Hz. [16]
8. Describe the hydrothermal method of preparation of powders of oxides and hydroxides. [16]

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**R07****Set No. 4**

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**Time: 3 hours****Max Marks: 80**

**Answer any FIVE Questions**  
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1. (a) Discuss the effect of mold and slurry parameter in slip casting.  
(b) What are the materials and their functions for tape casting of  $Al_2O_3$ . [8+8]
2. With a neat sketch explain the salient features of  $MgO-Al_2O_3-SiO_2$  ternary system? [16]
3. (a) What are the Metal Alkoxides?  
(b) Describe the preparation of Metal Alkoxides. [8+8]
4. With neat sketches explain the free-energy composition diagrams for:  
(a) Ideal solutions  
(b) Regular solutions  
(c) Incomplete solid solutions. [6+5+5]
5. Describe the various methods used in the chemical characterization of geological raw materials used in traditional ceramics? [16]
6. Explain how you can experimentally distinguish among crystalline  $SiO_2$ ,  $SiO_2$  glass, silica gel and liquid silica? Explain in terms of the structures of these different forms of the same composition ? [16]
7. (a) What are the various methods of compaction of powders?  
(b) Write a short essay on the principle of Hot Pressing (HP) of powders. [8+8]
8. Describe the production of  $Si_3N_4$  by vapor plasma reaction and by carbo thermal reduction of  $SiO_2$ . [16]

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1. Describe the powder preparation of  $Al_2O_3$  by precipitation. [16]
2. (a) What is slip casting? What is its principle?  
 (b) Discuss the effect of particle size, shape and degree of flocculation on the porosity of slip cast product. [8+8]
3. Describe hydrolysis, condensation and gelation stages in sol-gel process for fabrication of ceramics. [16]
4. Describe the following raw materials which are used in ceramic industry:  
 (a) Hydrous silicates  
 (b) Anhydrous silicates  
 (c) clay minerals. [5+5+6]
5. (a) Discuss briefly about Hot Isostatic Pressing (HIP) variables.  
 (b) What are the advantages of Hot Isostatic pressing (HIP) over Hot Pressing (HP)? [8+8]
6. (a) With a neat sketch explain the metastable phases that occur in the  $SiO_2$  system?  
 (b) Describe the dynamic methods of determining phase-equilibrium diagrams? [8+8]
7. Describe how would you experimentally determine the fractional porosity, fractional glass content, and fractional crystal content in steatite porcelain containing three phases (pores, glass and  $MgSiO_3$  crystals). [16]
8. Explain reasons for the following observations:  
 (a) Many ceramics are layer silicates with structures which contain a layer of octahedrally coordinated Al and a layer of tetrahedrally coordinated Si. In such structures Al often substitutes for Si, But Si never substitutes for Al.  
 (b) Many oxides are based on close-packed arrays of ions. Relatively few structures are based on hexagonal close packing in spite of the fact that the densities of both arrays are equal. [8+8]

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**R07****Set No. 3**

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1. (a) What is tape casting? When it is preferred?  
 (b) With the help of a schematic diagram describe tape casting process. [8+8]
2. (a) What are traditional ceramics? Give their applications.  
 (b) Describe ceramic super conductors. [8+8]
3. Draw a neat sketch of  $\text{MgO-Al}_2\text{O}_3$  -  $\text{SiO}_2$  ternary system and identify the general composition areas of various ceramic products on this diagram? [16]
4. (a) With a neat sketch explain the ionic structure of Wurtzite?  
 (b) With a neat sketch explain the ionic structure of Zinc blende? [8+8]
5. Explain how SiC is produced by sol-gel process. [16]
6. Describe gel densification during firing in sol-gel process of processing of ceramics. [16]
7. Suppose that the formation of Mullite from alumina and silica powder is a diffusion controlled process. How would you prove it? If the activation energy is 50Kcal/mole and the reaction proceeds to 10% of completion at  $1400^\circ\text{C}$  in 1hr, how far will it go in 1hr at  $1500^\circ\text{C}$ ? in 4hr at  $1500^\circ\text{C}$ ? [16]
8. (a) What are the advantages of Hot Pressing (HP)? For what type of powder materials is this method preferred?  
 (b) What are the additional factors required in design and construction of dies, punches etc for Hot Pressing (HP)?  
 (c) Compare Hot Pressing (HP) and cold die compaction. [8+8]

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