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202

National Institute of Technology Hamirpur

Department of Materials Science and Engineering

End-Term Examination (B-Tech 3rd year)

Ceramics Science and Engineering (MS-312)

Name:

Roll No.

Maximum time allowed: 180 min

Instructions:

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Total marks: 50

- All the questions are compulsory to attempt.
- Only one option is correct in multiple choice questions.
- Answer all questions to the point based on marks allocated to the question along with neat and proper schematics.

Q1. Multiple Choice Questions: $[1 \times 10 = 10]$ 1. Which one of the following materials is ferroelectric in nature? (a) SiO_2 (b) CaO (c) BaTiO₃ (d) TiO_2 2. Which of the following bonds is a secondary bond? (a) Ionic bond (b) Hydrogen Bond (c) Covalent bond (d) Metallic bond 3. What is the coordination number for cation in Corundum (Al₂O₃) ceramic structure. (a) 2 (b) 4 (c) 6(d) 8 4. Which one of the following possess highest magnetism? (a) Fe^{2+} (b) Fe^{3+} (c) Ti^{4+} (d) Zn^{2+} 5. Which one of the following materials does not possess permanent dipole moment? (a) Ferromagnetic (b) Ferrimagnetic (c) Diamagnetic (d) Paramagnetic 6. Which one of the following oxides is a good glass former? (a) CaO (b) MgO (c) SiO_2 (d) Na_2O 7. Which type of indenter is used in Vickers hardness test? (a) Spherical (b) Square Pyramid (c) Needle (d) Triangular pyramid

8. When all of the four corners of SiO4⁴⁻ tetrahedra share oxygen atoms, which of following silicate structure forms?

(a) Chain (b) Sheet (c) Island (d) 3D-network

and the state of the second second and the second 9. Which of the following is not a usual property of ceramic material? (a) High hardness (b) High ductility (c) Low toughness (d) More Brittleness 10. The conversion of glass to glass-ceramics: (a) Increases transparency (b) Decreases Transparency (c) Transparency remains unaffected (d) Transparency may either increase or decrease Q2. Write down the steps involved in producing alumina ceramic powder using Bayer's process? [2] Q3. What is the difference between acid and basic refractories? [2] Q4. Define glass and glass-ceramics? What is the difference between network formers and network modifiers with examples? [2] Q5. What is the difference between uniaxial pressing and isostatic pressing? Discuss their main advantages and disadvantages. [2] Q6. Difference between physical and chemical beneficiation? [2] Q7. Which of the mechanical properties are possible to measure with the help of nanoindentation? Give a brief concept about it. [2] Q8. Give difference between photosensitive and photochromic glasses? [2] Q9. What is the role of electronegativies of cation and anion in ionic compound in deciding the ionic and covalent character of bonds? [2] Q10. Explain sintering? Explain its mechanism with proper schematic? What is the difference between solid state sintering and liquid state sintering. [4] Q11. (a) Calculate the density of MgO which has the sodium chloride crystal structure. Given the ionic radii are $Mg^{2+} = 0.066$ nm and $O^{2-} = 0.132$ nm. The atomic masses of Mg and O are 24.312 and 16.00 g/mol. (b) Predict the coordination number and coordination polyhedron formed around cation for ionic solids A⁺B⁻ and C⁺B⁻. Use the following ionic radii for the prediction: $A^+ = 0.170 \text{ nm}, C^+ = 0.102 \text{ nm}, B^- = 0.181 \text{ nm}.$ [2+2=4]Q12. Draw and explain the fluorite CaF_2 crystal structure? What is the coordination number of cation and anion in it? [4] Q13. Explain with the help of proper schematic Pilkington float glass process? [4] Q14. Describe the steps involved in slip-casting process for ceramic products? What is the difference between (a) drain and (b) solid slip casting [4] Q15. Which test is commonly used to measure the fracture stress and fracture toughness of ceramic material? Explain it in detail with proper schematic and derive the fracture stress formula? [4]