

Vikram

20/11/23

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## National Institute of Technology Hamirpur

End semester Examination -2023

MS-312: Ceramic Science and Engineering

Time: 180 Minutes

Max Marks: 50

Note: This question paper contains 2 pages and 10 questions, and it is mandatory to attempt all the questions and each question is of five marks only.

1. A common form of the potential energy of interaction between atoms is given by
$$U = -A/r^6 + B/r^{12}$$
Where, A and B are constants
  - a. Derive an expression for the equilibrium distance of separation in terms of A and B.
  - b. If  $r_0 = 0.25\text{nm}$  what is the ratio of B to A?
  - c. Derive an expression for the energy at the equilibrium separation distance in terms of A
2.
  - (a) Draw and explain potential energy curve surface and interior atoms.
  - (b) Why ferrimagnetic are preferred over ferromagnetic materials?
3. Explain in details; the phenomenon of ferrimagnetism in ceramics materials.
4. Calculate the saturation magnetization for  $\text{Fe}_3\text{O}_4$ ; given that each cubic unit cell contains 8  $\text{Fe}^{2+}$  and 16  $\text{Fe}^{3+}$  ions and that the unit cell edge length is 0.839 nm.
5. What is ferroelectricity? With the help of diagram, explain the phenomenon of ferroelectricity in detail.
6. Briefly explain the following:
  - (a) Why thermal stresses introduced into a structure by rapid heating or cooling.
  - (b) For cooling and heating, what are the natures of the surface stresses?
  - (c) Why Magnesium is a better conductor of heat than magnesium oxide?
  - (d) In metals the electrical and thermal conductivities are correlated, but why not in the case of ceramic and polymers?
  - (e) Why vacuum is an excellent thermal insulator.
7. What is thermal coefficient of expansion? Using potential energy curve, Explain in details the thermal coefficient of expansion phenomenon in ceramics materials.
8. What is the difference between the following terms:
  - (a) Stress intensity and critical stress intensity
  - (b) Toughness and Fracture Toughness

- (c) Cracks in metals and cracks in ceramics
  - (d) Elastic strain energy and surface energy associated with cracks
  - (e) Yield strength and tensile strength.
9. Differentiate between following methods of ceramic processing:
- (a) Cold isostatic pressing and hot isostatic pressing.
  - (b) Slip casting and Drain casting
10. With a neat diagram, describe the **Pilkington process** of float glass fabrication. Why this method is prominently used in industry.