SHIV NADAR
INSTITUTION OF EMINENCE DEEMED TO BE UNIVERSITY
DELHI NCR

Mid Sem exam

Name of the Course: Materials Science and Engineering

Marks: 30
Course Instructor: Dr. Ranjit Kumar

Course Code: MED201
Time: 2 Hours

Section – A

1x5 = 5 Marks

1. What are the two important components of a smart material?
2. Write the electron configuration of Cr^{+} and Mg.
3. What are the possible sets of quantum numbers for $4p^2$ electrons?
4. Draw an orthorhombic unit cell and clearly mention the relationship between lattice constants a, b, c, and interfacial angles α, β, γ.
5. In a cubic unit cell there are two points at 0, 0, 1(A) and 1/2, 1, 0 (B). What are Miller indices of direction AB?

Section B: Answer any 5

3x5 = 15 marks

6. Classify the materials into major classes and mention important properties associated with each class.
7. If the activation energy of a reaction is 9.13 kJ, then what is the percent increase in the rate constant when the temperature is increased from 27 °C to 69 °C?
8. Sketch within a cubic unit cell the following planes:
   (a) $2\,\bar{1}\,\bar{1}$ (b) $1\,\bar{2}\,3$ (c) 4 2 1
9. The metal rubidium has a BCC crystal structure. If the angle of diffraction for the (321) set of planes occurs at 27.00° (first-order reflection) when monochromatic x-radiation having a wavelength of 0.0711 nm is used, compute the interplanar spacing for this set of planes, and the lattice constant for the rubidium metal.
10. (a) If the intercept of a crystal plane on x, y and z direction is ½, 1, ¾ , then find the Miller indices of this crystal plane.
    (b) Explain the stability and metastability in a mechanical system.
11. (a) Why is PVC soft and flexible but bakelite is hard and brittle?
    (b) On the basis of ionic radii of Fe^{2+} (0.077 nm) and O^{2-} (0.140 nm), predict the coordination number of Fe^{2+} and the crystal structure for FeO?

Section C: Answer any 2 **5x2 = 10 marks**

12. (a) Explain the Schottky defect using a suitable example. What are the causes of Schottky's defect?

    (b) Calculate the planar density of (100) of Fe having BCC structure, if radius of Fe is 0.1241 nm.

13. (a) Calculate the atomic packing factor of FCC unit cell.

    (c) Niobium has a BCC crystal structure, an atomic radius of 0.143 nm and an atomic weight of 92.91 g/mol. Calculate the theoretical density for Nb.

14. (a) Cite two reasons why there must be a strong bond between fiber and matrix at their interface.

    (b) Compute the % ionic character of the interatomic bond for TiO_2, if the electron negativity of Ti is 1.54 and that of O is 3.44.