

Time: 2 ½ hours

60 Marks

Note: All questions are compulsory.

Figures to the right indicate full marks.

Symbols have their usual meaning unless otherwise stated.

Use of log tables/ non-programmable calculator is allowed.

**Q. 1 (a) Attempt any one (08)**

- i. Describe permanent dipole bonding and explain hydrogen bonding among water molecules.
- ii. Explain what is meant by directions in cubic unit cell with suitable examples.

**(b) Attempt any one (04)**

- i. Define a composite material. Give an example of a composite material.
- ii. How many atoms per unit cell are there in the HCP crystal structure? Give your answer for the primitive cell as well as state the co-ordination number of atoms present in HCP unit cell. Also state the ideal c/a ratio for HCP metals.

**Q. 2 (a) Attempt any one (08)**

- i. Describe the homogenous nucleation process for the solidification of pure metals. What are the two energies involved in the transformation?
- ii. Explain steady state diffusion and derive the equation for Fick's first law of diffusion. Write down the factors that affect the diffusivity.

**(b) Attempt any one (04)**

- i. Distinguish between homogenous and heterogenous nucleation.
- ii. Write down the effects of temperature on diffusion in solids.

**Q. 3 (a) Attempt any one (08)**

- i. Explain the recrystallisation process of plastically deformed metals and state the important factors that affect the process in metals and alloys
- ii. Explain in general terms creep of metals

**(b) Attempt any one (04)**

- i. Explain the process of forging with suitable examples.
- ii. Describe the three stages in the ductile fracture of metal.

**Q. 4 (a) Attempt any one (08)**

- i. What is a binary isomorphous alloy system?
- ii. Derive the lever rule for the amount in weight percent of each phase in two-phase regions of a binary phase diagrams.

**(b) Attempt any one**

**(04)**

- i. Write down the Gibbs Phase Rule and define each of the term. Using Gibbs equation in pure water PT equilibrium phase diagram determines how many degrees of freedom are there along the freezing line.
- ii. Explain how a cored structure is produced in a 70% Cu- 30 % Ni alloy.

**Q. 5 Attempt any four**

**(12)**

- i. Calculate the percentage ionic character of the semiconducting compound CdTe and InP (their electro-negativities are: Cd=1.5, Te=2.0, In=1.5 and P=2.1)
- ii. Sketch the (110) crystallographic plane in a BCC unit cell and list the position of the atoms whose centres are intersected by this plane.
- iii. Short note on interstitial solid solutions.
- iv. Explain non-steady state diffusion.
  - v. What are the parameters that characterize the fluctuating stress cycles?
  - vi. How is the hardness of a material determined by a hardness testing machine?
  - vii. Distinguish between a terminal phase and an intermediate phase.
  - viii. Define a phase in a material and a phase diagram.

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