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10ME32A/AU32A/MT32/TL32

**Third Semester B.E. Degree Examination, June/July 2015**  
**Material Science and Metallurgy**

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting  
atleast TWO questions from each part.**

**PART – A**

- 1
  - a. Define APF and calculate APF for FCC crystal structure. (06 Marks)
  - b. Cesium crystallizes in a certain type of cubic structure with lattice constant  $6.14\text{\AA}$ . Identify the exact type of crystal structure in which cesium crystallizes. The atomic weight and density of cesium are 132.91 and  $1900\text{ kg/m}^3$  respectively. Also determine the total number of cesium atoms per cubic meter in the crystal structure. (05 Marks)
  - c. Differentiate between edge dislocation and screw dislocation. (05 Marks)
  - d. State and briefly explain the factors affecting diffusivity (any 4). (04 Marks)
  
- 2
  - a. A cylindrical specimen of aluminum having a diameter of 20mm and length 200mm is deformed elastically in tension with a force of 48800N. Determine the following:
    - i) The amount by which the specimen will elongate in the direction of applied stress.
    - ii) The change in diameter of specimen.
    - iii) Will the diameter increase or decrease.  
(Given:  $E = 69\text{ GPa}$  and Poisson's ratio = 0.33 for Al). (07 Marks)
  - b. What is true stress and engineering stress and obtain the mathematical equation showing the relation between true stress and engineering stress. (07 Marks)
  - c. Explain plastic deformation by twinning with a neat sketch. (06 Marks)
  
- 3
  - a. Differentiate between ductile fracture and brittle fracture. (05 Marks)
  - b. What is stress relaxation? Obtain the mathematical expression for it. (08 Marks)
  - c. What is fatigue? With neat sketches explain the typical fatigue stress cycles briefly. (07 Marks)
  
- 4
  - a. Define solidification and explain nucleation and grain growth of a metal or alloy with neat sketches. (08 Marks)
  - b. Briefly explain the factors by Hume-Rothery that governs the formation of a solid solution. (05 Marks)
  - c. Define solid solution and explain different types of solid solution with neat sketches. (07 Marks)

**PART – B**

- 5
  - a. What are cooling curves? And draw the cooling curves for i) Pure metal ; ii) Binary solid solution. (05 Marks)
  - b. Draw the Iron-Carbon equilibrium diagram, show all the phases on the diagram and briefly explain it. (10 Marks)
  - c. What is an invariant reaction in the Iron-Carbon phase diagram? Explain the Eutectic reaction and peritectic reaction. (05 Marks)

- 6 a. Draw the TTT diagram for eutectoid steel (0.83% C) and explain briefly different microstructures obtained at various cooling rates. (10 Marks)
- b. Differentiate between Austempering and Mar tempering. (05 Marks)
- c. Explain induction hardening with a neat sketch. (05 Marks)
- 7 a. Give the composition, micro structure and applications of
- i) Low carbon steel (mild steel)
- ii) Medium carbon steel
- iii) High carbon steel. (09 Marks)
- b. Write a note on brasses. (06 Marks)
- c. Explain briefly SAE-AISI designation of steels. (05 Marks)
- 8 a. What is a composite material and explain the
- i) Role of matrix
- ii) Role of interface and
- iii) Role of reinforcement in a composite material. (10 Marks)
- b. With a neat sketch, explain the resin transfer moulding process. (06 Marks)
- c. What are the applications of composites (any 4). (04 Marks)

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