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10MEA402/10AUA402

Fourth Semester B.E. Degree Examination, June/July 2018

**Material Science and Metallurgy**

Time: 3 hrs.

Max. Marks:100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

**PART – A**

- 1 a. Define atomic packing factor. Calculate the atomic packing factor for HCP. (Given  $c = 1.633a$ ). (08 Marks)
- b. Zinc has HCP structure. The height of unit cell is 0.494 nm. The nearest neighbor is at a distance of 0.27 nm. Calculate the volume of unit cell of Zinc. (04 Marks)
- c. State and explain Fick's laws of diffusion. (08 Marks)
- 2 a. Define:
  - i) Resilience
  - ii) Ultimate tensile strength,
  - iii) Ductility,
  - iv) Malleability. (06 Marks)
- b. A 12.5 mm diameter aluminium alloy test bar is subjected to a load of 2 tons (two). If the dia of the bar is 12.4 mm at this load. Calculate engineering strain engineering stress, true stress and true strain. Assume no change in volume. (08 Marks)
- c. Differentiate between slip and twinning deformation in materials. (06 Marks)
- 3 a. Differentiate between ductile and brittle fracture with sketches. (07 Marks)
- b. Define creep. With a typical creep curve, explain the different stages of creep. (07 Marks)
- c. Draw and explain S-N diagram for mild steel and aluminium alloy. (06 Marks)
- 4 a. With neat sketches, explain the different types of cast metal structure. (08 Marks)
- b. Define solid solution and explain the different types of solid solution with sketches. (07 Marks)
- c. What are Hume-Rothery rules? Explain. (05 Marks)

**PART – B**

- 5 a. Draw the iron-carbon equilibrium diagram and label all phase fields and the invariant reactions involved. (10 Marks)
- b. Two metals A and B are used to form an alloy containing 75% A and 25% B. A melts at 650°C and B at 450°C. When alloyed together, A and B do not form any compound in intermediate phase. The solid solubility of metal A in B and B in A are negligible. The metal pair forms an eutectic at 40% A and 60% B which solidifies at 300°C. Assume the liquidus and solidus lines are to be straight. Draw the phase diagram for the alloy series and find:
  - i) The temperature at which alloy starts and completes solidification.
  - ii) Percentage of eutectic in the alloy at room temperature. (Assume R.T. = 25°C). (10 Marks)

- 6 a. Draw the TTT diagram for plain carbon eutectoid steel and explain the critical cooling rate (CCR). (08 Marks)
- b. Differentiate between normalizing and annealing. (05 Marks)
- c. Define hardenability. Describe a test to determine hardenability of steel. (07 Marks)
- 7 a. Give the composition, properties and uses of:
- i) Malleable Cast Iron (08 Marks)
- ii) S.G. Iron. (05 Marks)
- b. Explain briefly the effect of alloying elements on properties of steel. (05 Marks)
- c. Write notes on composition, properties and uses of:
- i) Alpha brasses (07 Marks)
- ii) Merntz metal
- 8 a. Define a composite material. How are composite materials classified? (06 Marks)
- b. With a neat sketch, explain filament winding technique. (07 Marks)
- c. Write notes on advantages, limitations and applications of composite materials. (07 Marks)

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