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10ME42A/AU42A

**Fourth Semester B.E. Degree Examination, June/July 2016**  
**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. Distinguish between BCC, FCC and HCP crystals with respect to structure, No. of atoms, Lattice constant, Co-ordination number and APF. (08 Marks)
  - b. What is Berger's vector? Explain its significance using edge dislocation. (04 Marks)
  - c. i) What is Diffusion? Explain the factors affecting diffusion. (04 Marks)  
 ii) The diffusivity of iron atoms in the BCC Fe lattice is  $2.1 \times 10^{-23} \text{ m}^2/\text{S}$  at  $400^\circ\text{C}$  and  $4.0 \times 10^{-16} \text{ m}^2/\text{S}$  at  $800^\circ\text{C}$ . Calculate the activation energy in Joules per mole for diffusion of iron atoms in BCC Fe lattice in this temperature range. Take  $R = 2.3 \times 8.314 \text{ J/mol} - \text{K}$ . (04 Marks)
- 2
  - a. With the help of Stress – Strain diagram, explain any Four mechanical properties in plastic region. (08 Marks)
  - b. Derive an expression for true strain and convention strain. (04 Marks)
  - c. What is Plastic Deformation? With a neat sketch, explain the mechanism of Twinning. (08 Marks)
- 3
  - a. What is Fracture? Derive an expression for fracture strength of a real material based on Griffith's theory of brittle fracture. (08 Marks)
  - b. Briefly discuss the factors affecting creep. (04 Marks)
  - c. What is Fatigue? Briefly explain R.R Moore fatigue testing and plot S – N curves for mild steel and Aluminium alloy. (08 Marks)
- 4
  - a. i) What is Solidification? Derive an expression for critical radius of Nucleus and explain its importance. (05 Marks)  
 ii) Write in brief note on Cast Metal Structures. (05 Marks)
  - b. i) What are Solid Solutions? Briefly discuss Hume Ruthery Rules for the formation of substitutional solid solutions. (05 Marks)  
 ii) Explain the application of Gibb's phase rule for a Binary phase diagram. (05 Marks)

**PART – B**

- 5
  - a. What is a Phase Diagram? Explain its significance. (04 Marks)
  - b. The melting point of lead is  $327^\circ\text{C}$  and that of tin is  $232^\circ\text{C}$ , they form an Eutectic of 62% tin and 38% lead at  $183^\circ\text{C}$ . At Eutectic temperature, maximum solubility of tin in lead is 19% and lead in tin is 3%. Assume their solid solubilities at  $0^\circ\text{C}$  is 0%, liquidus solidus and solvus lines to be straight. Draw phase diagram to scale indicating all phase fields and explain the solidification of 30% tin and 70% lead alloy. (08 Marks)
  - c. Draw Iron – Cementite phase diagram showing all Phase fields, Critical temperature and Invariant reactions. (08 Marks)

- 6 With neat sketches, explain the following :
- a. TTT – Diagram. (05 Marks)
  - b. Normalizing heat treatment. (05 Marks)
  - c. Flame hardening. (05 Marks)
  - d. Age – hardening of Al - Cu Alloys. (05 Marks)
- 7 Briefly explain the structure, properties, composition and applications of the following :
- a. Types of CAST IRONS. (10 Marks)
  - b. Alloys of copper (any four). (10 Marks)
- 8
- a. What are Composites? Mention any four advantages and applications of composites. (06 Marks)
  - b. With a neat sketch, explain the fabrication of FRP's by any one method of open mould processes. (06 Marks)
  - c. With a neat sketch, explain the production of MMC's by Stir casting technique. (08 Marks)

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