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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 2.1×10^{-23} m^2/S at 400^0C and $4.0 \times 10^{-16} m^2/S$ at 800^0C. 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 × 8.314 J/mol – 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 327^0C and that of tin is 232^0C, they form an Eutectic of 62% tin and 38% lead at 183^0C. At Eutectic temperature, maximum solubility of tin in lead is 19% and lead in tin is 3%. Assume their solid solubilities at 0^0C 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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