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06ME32A

Third Semester B.E. Degree Examination, June/July 2011
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. Determine the coordination number and atomic packing factor for BCC lattice. (05 Marks)
b. The unit cell of chromium is cubic and contains two atoms. Determine the dimension of the chromium unit cell. [Given : atomic weight of Cr = 52, and density of Cr = 7.19 Mg m^{-3}]. (05 Marks)
c. What is crystal imperfection? Give the list of crystal imperfections, and explain any two. (05 Marks)
d. A plate of iron is exposed to carbon – rich and carbon – deficient conditions on two sides at 700°C . Calculate the diffusion flux of carbon through the plate if the concentration of carbon at the positions of 5mm and 10 mm beneath the carburizing surface are 1.2kg/m^3 and 0.8 kg/m^3 respectively. $D = 3 \times 10^{-11} \text{ m}^2/\text{s}$ at this temperature. (05 Marks)
2. a. Define engineering stress and strain, and true stress and strain. Find out the relationship between true strain and engineering strain. (08 Marks)
b. A copper rod of initial diameter 2mm fractures at a load of 110 kg. It's ductility is 75% reduction in area. Calculate the true stress at fracture. (06 Marks)
c. A zinc crystal is being pulled in tension with the normal to its basal plane at 60° to the tensile axis, and with a slip direction at 40° to the tensile axis.
i) What is the resolved shear stress, τ , acting in the slip direction when a tensile stress of 0.69 MPa is applied?
ii) What tensile stress is necessary to reach the critical resolved shear stress, τ_c , of 0.94 MPa? (06 Marks)
3. a. What is Griffith's theory of brittle fracture? Derive the equation for critical stress for crack propagation. (07 Marks)
b. What are the factors affecting the fatigue life? (04 Marks)
c. Explain with sketch the different stages of creep deformation. What is the effect of stress and temperature on creep curve? (09 Marks)
4. a. Explain Hume – Rothery rules for solid solution behavior. (05 Marks)
b. Draw a binary phase diagram where the two metals are completely soluble in both solid and liquid state. State Gibb's phase rule and apply it to analyze different regions of the phase diagram. (10 Marks)
c. What is an invariant reaction? Illustrate peritectic invariant reaction with a neat diagram. (05 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, $42+8=50$, will be treated as malpractice.

PART – B

- 5 a. Draw Fe – Fe₃C phase diagram and label all the parts. Show the invariant points on it. Write the reactions occurring at these points indicating the temperature and composition of each point. (09 Marks)
- b. With the help of the phase diagram, explain the solidification process of 0.6% C steel, as it cools from liquid phase, showing the microstructures at different stages. (06 Marks)
- c. What is critical cooling rate? On what factors does it depend? (05 Marks)
- 6 a. Define the process of heat treatment and classify the various heat treatment processes. (04 Marks)
- b. Define hardenability. Explain with neat sketches how you find it by Jominy – End quench test. (08 Marks)
- c. Explain austempering and martempering with figures. (08 Marks)
- 7 a. Discuss AISI – SAE designation of steels, with examples. (06 Marks)
- b. What are the salient features of cast iron? Discuss the classification of cast iron based on microstructure. (06 Marks)
- c. Discuss the composition, properties, and uses of α - brasses and bronzes. (08 Marks)
- 8 a. Explain any four methods of preventing corrosion. (08 Marks)
- b. Write short notes on :
- i) Single metal galvanic cell corrosion.
 - ii) Passivation in stainless steel.
 - iii) Intergranular corrosion. (12 Marks)

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