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10MEA/AUA302

Third Semester B.E. Degree Examination, June/July 2018
Material Science & Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Illustrate the following point defects which disrupt the perfect arrangement of the surrounding atoms in a crystal structure. **(15 Marks)**
(i) Vacancy (ii) Interstitial atom (iii) Small substitutional atom
(iv) Large substitutional atom. (v) Frenkel defect.

b. What is atomic diffusion? Mention any 3 examples of diffusion. **(05 Marks)**

2 a. Discuss how the stress-strain behavior of iron varies with temperature. **(12 Marks)**

b. An aluminum specimen originally 300 mm long is pulled in tension with a stress of 280 MPa. If the deformation is entirely elastic, what will be the resultant elongation? E for Aluminum is 69 GPa. **(03 Marks)**

c. A tensile stress is applied along the longitudinal direction of a cylindrical aluminum rod that has a diameter of 10 mm. Determine the magnitude of the load required to produce a 2.5×10^{-3} mm change in diameter, if the deformation is entirely elastic. E for aluminum is 69 GPa, Poisson's ratio for Al is 0.33. **(05 Marks)**

3 a. Present a schematic representation of the typical constant load creep behavior of metals and discuss. **(08 Marks)**

b. What is fatigue limit? Also, discuss the stress amplitude (s) versus logarithm of the number of cycles (N) to fatigue failure of metals for, (i) a material that displays a fatigue limit and (ii) a material that does not display a fatigue limit. **(12 Marks)**

4 a. Explain with necessary diagrams, how the macrostructure (ingot structure) of a casting develops during solidification. **(12 Marks)**

b. State the Gibbs phase rule. **(02 Marks)**

c. Explain the Hume-Rothery rules for extensive solid solubility of one element in another. **(06 Marks)**

PART – B

5 a. Illustrate the microstructures for an iron-carbon alloy of eutectoid composition, above and below the eutectoid temperature. **(12 Marks)**

b. Determine the composition of each phase in a Cu-40% Ni alloy at 1300°C, 1270°C, 1250°C and 1200°C (Use Fig. Q5 (b)). **(08 Marks)**

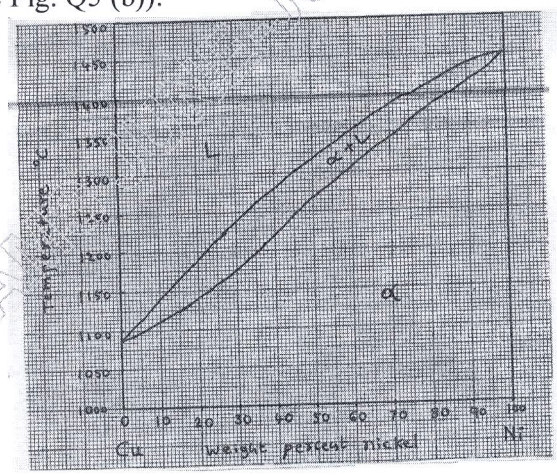

Fig. Q5 (b)

6 a. Illustrate the formation of quench cracks in steels, when they are quenched. Also, discuss the marquenching heat treatment designed to reduce residual stresses and quench cracking. **(10 Marks)**

b. Illustrate the setup for the Jominy test used for determining the hardenability of steel. Also show hardenability curves for several steels. **(10 Marks)**

7 a. Show schematically the microstructures of the following types of cast iron : Gray iron, White iron, Malleable iron, ductile iron and compacted graphite iron. **(10 Marks)**

b. List the properties and applications of copper and aluminum alloys. **(10 Marks)**

8 a. What are composite materials? How they are classified? **(07 Marks)**

b. Illustrate the following production methods:
(i) Hand lay-up method for molding fiber reinforced plastic.
(ii) Filament winding process for producing fiber-reinforced plastic composite material. **(10 Marks)**

c. Schematically represent the following types of fiber reinforced composites:
(i) Continuous and aligned fibers.
(ii) Discontinuous and aligned fibers.
(iii) Discontinuous and randomly oriented fibers. **(03 Marks)**

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