USN ☐☐☐☐☐☐☐☐☐☐   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 A*l* 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)**
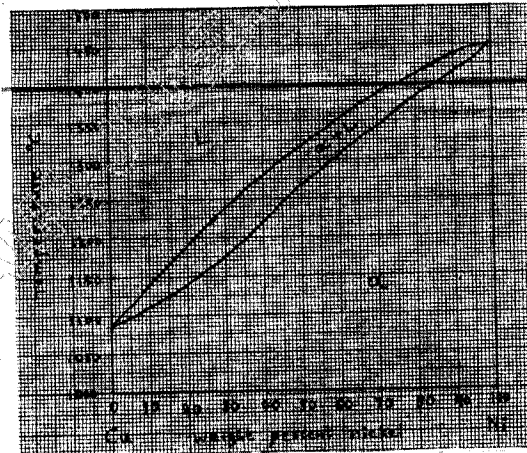

Fig. Q5 (b)

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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