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15ME/MA32

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Material Science

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define APF. Calculate the APF for an ideally packed HCP unit cell. (07 Marks)
  b. Classify the crystal defects. Explain point defect with neat sketches. (07 Marks)
  c. Calculate the rate of diffusion of iron at 700°C. Take $A = 4.9 \times 10^{-5}$ m^2/s, $E = 153.2$ kJ/mol. (02 Marks)

OR

2 a. List linear and non-linear elastic properties. Explain non-linear elastic properties. (06 Marks)
  b. Draw S-N curve and typical creep curve. Explain them briefly. (10 Marks)

Module-2

3 a. Explain the rules governs the formation of solid solution. (04 Marks)
  b. What are the different cast metal structures? Explain with neat sketches. (04 Marks)
  c. Draw Fe-Fe$_3$C diagram. Explain the reactions in it. (08 Marks)

OR

4 a. Define homogeneous and heterogeneous nucleation. Obtain an expression for critical radius of nucleus. (06 Marks)
  b. Explain the effect of alloying elements to the steel. (04 Marks)
  c. Two metals A and B have their melting points at 600°C and 400°C respectively. These metals do not form any compound or intermetallic phase. The maximum solubility in each other is 4% which remains the same until 0°C. An eutectic reaction occurs at 300°C for 65% A.
    i) Draw the phase diagram and label all the phases and fields.
    ii) Find the temperature at which 20% A and 80% B starts and ends solidification.
    iii) Find the temperature at which the same alloy contain 50% liquid and 50% solid. (06 Marks)

Module-3

5 a. Define heat treatment. Give its classification. (05 Marks)
  b. Distinguish between Austempering and Martempering. (05 Marks)
  c. Draw TTT diagram. Explain briefly. (06 Marks)

OR

6 a. With neat sketch explain Jominy end quench test. (06 Marks)
  b. Explain age hardening of Al-Cu alloys. (04 Marks)
  c. Explain the properties, compositions and uses of gray cast iron and SG iron. (06 Marks)

Module-4

7 a. Define ceramic. Explain briefly the types of ceramics. **(05 Marks)**
   b. List the applications and mechanical properties of ceramics. **(06 Marks)**
   c. Define smart material. Explain briefly the types of smart materials. **(05 Marks)**

OR

8 Write a note on:
   a. Shape memory alloys
   b. Piezo electric materials
   c. Fibre optic materials
   d. Use of non-destructive testing **(16 Marks)**

Module-5

9 a. Define composite. How do you classify composites? **(06 Marks)**
   b. Explain the role of matrix and reinforcement in composite material. **(06 Marks)**
   c. With flow chart explain the production of carbon fibres. **(04 Marks)**

OR

10 a. With a neat sketch explain pultrusion process. **(07 Marks)**
   b. List the advantages and applications of composites. **(05 Marks)**
   c. Calculate the tensile modulus of elasticity of unidirectional carbon fibre reinforced composite material which contain 62% by volume of carbon fibres in iso-strain and iso-stress condition. Take Young's modulus of carbon fibre as 37.86×10^4 N/mm^2. Young's modulus of epoxy $= 42 \times 10^2$ N/mm^2. **(04 Marks)**

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