



CBCS SCHEME

15ME/MA32

Third Semester B.E. Degree Examination, June/July 2019 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. Show that the atomic packing factor for HCP is 0.74. (05 Marks)
- b. Define the following : i) Diffusion flux ii) Fracture toughness iii) Proof stress
iv) Strain hardening. (04 Marks)
- c. A steel tank in a process industry contains nitrogen at 400⁰K and at a constant pressure of 15 atm. Vacuum exists outside the tank. Nitrogen concentration at the inner surface of the tank is equal to 12 kg/m³. The constant $D_0 = 5 \times 10^{-7} \text{ m}^2/\text{s}$ and activation energy for diffusion process between nitrogen and steel is 75 kJ/mol. Calculate the rate at which nitrogen escapes through the tank wall. The thickness of tank wall is 6mm. (07 Marks)

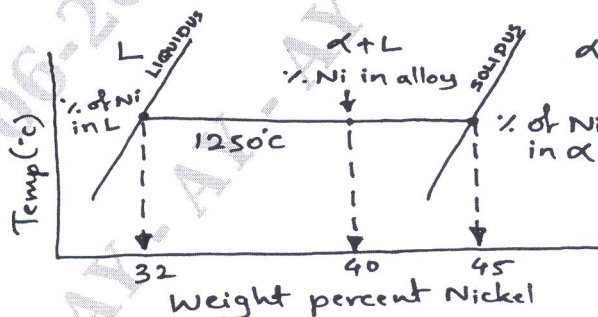
OR

- 2 a. A cylindrical specimen of steel having an original diameter of 12.8mm is tensile tested to fracture and found to have an engineering fracture strength σ_f of 460 MPa. If the cross sectional diameter at fracture is 10.7mm determine i) the ductility in terms of percent reduction in area ii) the true stress at fracture. (04 Marks)
- b. Explain the mechanisms of strengthening in metals. (06 Marks)
- c. Explain the following : i) Twin boundaries ii) S-N diagram iii) Three stages of creep. (06 Marks)

Module-2

- 3 a. Explain Hume Rothery conditions for unlimited solid solubility. (04 Marks)
- b. Explain the mechanism of solidification. (06 Marks)
- c. Calculate the amounts of α , L at 1250⁰C in the Cu - 40% Ni alloy shown in fig. Q3(c). (06 Marks)

Fig.Q3(c)



OR

- 4 a. Explain Eutectic system with a neat sketch in a Binary phase diagram. (08 Marks)
- b. Distinguish between substitutional and interstitial solid solution, with a neat sketch. (08 Marks)

Module-3

- 5 a. Draw Iron – Carbon equilibrium diagram upto 6.67% carbon. (08 Marks)
 b. Explain Annealing, with neat sketch. (05 Marks)
 c. List the purpose of normalizing. (03 Marks)

OR

- 6 a. Explain Age hardening of Al - Cu alloys, with neat sketch. (08 Marks)
 b. List the properties and composition of SG Iron and Steel. (08 Marks)

Module-4

- 7 a. Explain functional and structural classification of ceramic materials. (05 Marks)
 b. Explain Electrical and thermal properties of ceramic materials. (05 Marks)
 c. Write short notes on the following :
 i) Biocompatible materials
 ii) Direct and converse effect in piezoelectric material. (06 Marks)

OR

- 8 a. What is Smart material? Why piezoelectric material and SMA material are termed as Smart materials. (04 Marks)
 b. Explain briefly the following : i) Super elasticity ii) Mechanical behaviour of plastics iii) Fiber optics materials. (06 Marks)
 c. Differentiate between Thermosetting and Thermoplastic materials. (06 Marks)

Module-5

- 9 a. Are composite materials isotropic and / or homogeneous? Explain. (04 Marks)
 b. Evaluate expression for longitudinal Young's modulus of unidirectional lamina using strength of materials approach. (06 Marks)
 c. Explain the merits and demerits of MMC's. (06 Marks)

OR

- 10 a. Explain the classification of composite materials. (06 Marks)
 b. What is Hybrid composite? Explain the types of hybrid laminates. (04 Marks)
 c. Explain the applications of the following :
 i) Ceramic metal composites.
 ii) Metal matrix composites.
 iii) Polymer matrix composites. (06 Marks)

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