

# CBCS SCHEME

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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

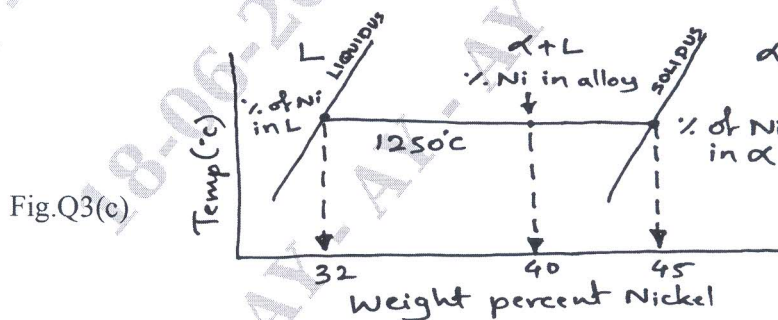
- 1 a. Show that the atomic packing factor for HCP is 0.74. (05 Marks)
- b. Define the following : i) Diffusion flux ii) Fracture toughness iii) Proof stress iv) Strain hardening. (04 Marks)
- c. A steel tank in a process industry contains nitrogen at  $400^0\text{K}$  and at a constant pressure of 15 atm. Vacuum exists outside the tank. Nitrogen concentration at the inner surface of the tank is equal to  $12 \text{ kg/m}^3$ . The constant  $D_0 = 5 \times 10^{-7} \text{ m}^2/\text{s}$  and activation energy for diffusion process between nitrogen and steel is  $75 \text{ kJ/mol}$ . 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  $a_f$  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  $\alpha$ , L at  $1250^0\text{C}$  in the  $C_u - 40\% \text{ Ni}$  alloy shown in fig. Q3(c). (06 Marks)



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)

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.

**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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