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18ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2021 Material Science

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Calculate APF for FCC crystal structure. (06 Marks)
- b. Discuss briefly point and line imperfections in crystals. (06 Marks)
- c. What is Fick's law of diffusion? Explain the factors affecting diffusion. (08 Marks)

OR

- 2 a. With a stress – strain diagram for mild steel. Explain yield strength, ductility, toughness and ultimate tensile strength. (06 Marks)
- b. Show that $\epsilon' = 1/n(1 + \epsilon)$. (04 Marks)
- c. A plain – carbon steel rod is subjected to a tensile load of 7000 kg. Assume no change in volume during extension, determine engineering stress, engineering strain, true stress and true - strain. The initial diameter of the rod is 13mm and the specimen under load is 12mm. (10 Marks)

Module-2

- 3 a. Discuss Type I, Type II and Type III fractures. (10 Marks)
- b. What is Fatigue? Explain fatigue testing with a sketch. (06 Marks)
- c. Explain three stages of Creep process. (04 Marks)

OR

- 4 a. What is a Solid solution? Discuss Hume – Rothary rules for formation of Solid - solution. (05 Marks)
- b. Draw a neat Iron – Carbon equilibrium diagram and label all phases and write invariant reactions like eutectoid, eutectic and peritectic reactions. (10 Marks)
- c. Derive an expression for critical radius in homogeneous nucleation and discuss the significance of this critical radius. (05 Marks)

Module-3

- 5 a. Explain Annealing, Normalizing and Hardening heat treatment processes. (06 Marks)
- b. With the help of TTT and CCT diagrams, explain mar tempering and give one industrial application. (10 Marks)
- c. What is Hardenability? Discuss various factors affecting hardenability. (04 Marks)

OR

- 6 a. Discuss 'Nitriding' and 'Flame – hardening' processes. (08 Marks)
- b. With Al – Cu phase diagram, explain age – hardening process. (08 Marks)
- c. Explain properties, composition and uses of Gray Cast Iron. (04 Marks)

Module-4

- 7 a. Give a broad classification of composites. (04 Marks)
- b. Discuss various applications of composites. (06 Marks)
- c. Explain 'Pultrusion process' for manufacturing composites. (10 Marks)

OR

- 8 a. Discuss 'Characterization of Composites'. (06 Marks)
b. Explain 'Filament winding process' for producing FRPs. (08 Marks)
c. Calculate the modulus of elasticity, tensile strength and the fraction of the load carried by the fibre for the following composite material stresses under iso strain condition. The composite consists of a continuous glass fibre – reinforced epoxy resin produced by using 60% by volume of E – glass fiber having a modulus of elasticity of $72400 \times 10^6 \text{ N/m}^2$ and a tensile strength of $2400 \times 10^6 \text{ N/m}^2$ and a hardened epoxy resin with a modulus of elasticity of $3100 \times 10^6 \text{ N/m}^2$ and a tensile strength of $60 \times 10^6 \text{ N/m}^2$. (06 Marks)

Module-5

- 9 a. Explain types and properties of Ceramics. (08 Marks)
b. Explain 'Injection and Moulding' process for producing polymers. (06 Marks)
c. List out various applications of ceramics and polymers. (06 Marks)

OR

- 10 a. What are Smart Materials? Discuss the functioning of shape memory alloy. (08 Marks)
b. Explain biological and other applications of SMA. (06 Marks)
c. What are the factors to be considered for the Selection of materials? Discuss. (06 Marks)

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