CBCS SCHEME

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18ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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. Define APF. Calculate APF for FCC unit cell. **(07 Marks)**

b. Explain briefly crystal imperfections/defects. Classify it and with neat sketches, explain grain boundary and tilt boundary defects. **(07 Marks)**

c. State and explain Fick's 2nd law of diffusion. **(06 Marks)**

OR

2 a. Define true stress and true strain. Show that

$$\sigma' = \sigma(\varepsilon + 1)$$

where σ = Engineering/conventional stress, σ' = True stress

ε = Engineering/conventional strain, ε' = True strain **(08 Marks)**

b. Explain the following: (i) Toughness (ii) Resilience (iii) Secant modulus **(06 Marks)**

c. Explain the following mechanisms of strengthening in metal:
(i) Grain size reduction
(ii) Solid solution strengthening
(iii) Strain hardening **(06 Marks)**

Module-2

3 a. Define creep. Explain with a neat sketch, primary, secondary and tertiary creep. **(07 Marks)**

b. What is fatigue? Explain S-N curve with a neat sketch. **(04 Marks)**

c. Draw iron-carbon equilibrium diagram showing all the phases. Explain the phases in iron-carbon equilibrium diagram. **(09 Marks)**

OR

4 a. Define solid solution. Explain the types of solid solutions with neat sketches. **(05 Marks)**

b. Write notes on: (i) Effect of non-equilibrium cooling (ii) Coring **(04 Marks)**

c. Define nucleation. Obtain an expression for critical radius in homogeneous nucleation. **(11 Marks)**

Module-3

5 a. Define heat treatment. Explain the TTT diagram for 0.83% C, showing all the phases. **(07 Marks)**

b. Define annealing. Explain full annealing and spherodizing annealing with neat sketches. **(07 Marks)**

c. Explain induction hardening with a neat sketch. **(06 Marks)**

OR

6 a. Define heat treatment. Give its purpose and classification. **(06 Marks)**

b. What is hardenability? Explain with a neat sketch, Jominy End Quench Test. **(07 Marks)**

c. Explain the composition, properties and uses of Grey C.I., White C.I. and Malleable C.I. **(07 Marks)**

Module-4

7 a. Define composite. Explain the role of matrix, reinforcement and interface. **(07 Marks)**

b. Explain with neat sketches, Pressure bag moulding and vacuum bag moulding process. **(06 Marks)**

c. Explain filament winding process. **(07 Marks)**

OR

8 a. Derive an expression for Young's modulus for FRPs for ISO-strain condition. **(06 Marks)**

b. Explain resin transfer moulding process. **(06 Marks)**

c. Explain powder metallurgy technique for the manufacture of composites. **(08 Marks)**

Module-5

9 a. Define ceramic. Explain the types of ceramics. **(07 Marks)**

b. Explain ISO-static pressing and hot pressing. **(06 Marks)**

c. Explain slip casting and tape casting processes. **(07 Marks)**

OR

10 a. Explain compression moulding process. **(07 Marks)**

b. Define smart material. Write a note on piezoelectrics and Shape Memory Alloys (SMA). **(07 Marks)**

c. Explain environmental considerations and sustainability. **(06 Marks)**

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