

# CBCS SCHEME



18ME34

## Third Semester B.E. Degree Examination, Jan./Feb. 2023 Material Science

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 2<sup>nd</sup> law of diffusion. (06 Marks)

OR

- 2 a. Define true stress and true strain. Show that  
$$\sigma' = \sigma(\epsilon + 1)$$
where  $\sigma$  = Engineering/conventional stress,  $\sigma'$  = True stress  
 $\epsilon$  = Engineering/conventional strain,  $\epsilon'$  = 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 spheroidizing 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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