USN ☐☐☐☐☐☐☐☐☐☐   **21ME33**

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

Time: 3 hrs.   Max. Marks: 100

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

Module-1

1 a. Classify engineering materials and compare crystalline solids and non-crystalline solids.
                                                                               (07 Marks)
   b. What are voids? Explain Tetrahedral voids and octahedral voids with suitable diagrams.
                                                                               (08 Marks)
   c. Briefly explain the steps to prepare a specimen for microstructural examinations. **(05 Marks)**

OR

2 a. What is meant by imperfections in solids? Explain edge dislocation and screw dislocation.
                                                                               (10 Marks)
   b. In crystallography, what is the theme of symmetry operation? Explain two fold and three fold rotation.
                                                                               (06 Marks)
   c. Define Planar Atomic Density and Atomic Packing Factor.   **(04 Marks)**

Module-2

3 a. Define solid solution. Describe the classification of solid solution.   **(07 Marks)**
   b. Draw iron-carbon equilibrium diagram. Explain various phases and locate invariant points.
                                                                               (08 Marks)
   c. Explain the method of measuring hardness in Rockwell Hardness test machine. **(05 Marks)**

OR

4 a. With a neat sketch, explain Fick's 1st and 2nd law of diffusion. **(08 Marks)**
   b. The solidus and liquidus temperatures for an alloy system containing two metals A and B which are completely soluble in liquid and solid states are presented in the table below. Metal 'A' melts at 1080°C and metal 'B' melts at 1450°C.
      (i) Construct the phase diagram for the system and label all regions.
      (ii) Predict the number, type, relative amounts and composition of phases present in an alloy containing 60% A and 40% B at 1250°C.

Sl. No.	Alloy composition (Wt %)	Solidus temp °C	Liquidus temp °C
1	90% A	1100°C	1175 °C
2	60% A	1160°C	1290 °C
3	20% A	1310°C	1400 °C

                                                                               (12 Marks)

Module-3

5 a. Deduce the expression for critical radius of nucleation.   **(07 Marks)**
   b. Draw and explain the process of flame hardening.   **(06 Marks)**
   c. Explain the test procedure of creep test.   **(07 Marks)**

OR

6 a. Explain normalizing heat treatment process. Also compare normalizing heat treatment with annealing. **(08 Marks)**
   b. Explain the concept of mechanisms behind strengthening in metals. Also explain strengthening by grain size reduction. **(07 Marks)**
   c. Explain Hardening heat treatment in brief. **(05 Marks)**

Module-4

7 a. Explain common types of coatings techniques in brief. **(10 Marks)**
   b. Briefly explain different types of mechanical methods of powder production techniques. **(10 Marks)**

OR

8 a. What is meant by sintering process? Explain liquid phase and activated sintering. **(07 Marks)**
   b. How the particle size and particle shape influences the characterization of metal powders? **(06 Marks)**
   c. Explain the wear test and state the important of conducting wear test. **(07 Marks)**

Module-5

9 a. Explain the need for material selection process in design. **(05 Marks)**
   b. What are the different types of design? Explain each type. **(07 Marks)**
   c. Explain the procedure for measuring hardness by Brinell's Hardness testing equipment. **(08 Marks)**

OR

10 a. What are the different functional properties of material? Explain thermal properties. **(06 Marks)**
   b. Describe in brief about the factors affecting the selection of materials. **(06 Marks)**
   c. The following data is noted in a tensile test. Diameter of specimen = 200 mm, extension under a load of 10 kN = 0.035 mm, load at yield point = 110 kN, maximum load = 190 kN. Length of specimen after failure = 255 mm, Neck dia = 12.25 mm. Determine :
   (i) Young's modulus   (ii) Yield stress   (iii) Ultimate stress
   (iv) Percentage elongation   (v) Percentage reduction in area **(08 Marks)**

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