



- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Compare different structures based on the atomic arrangement.
CO2	Examine various phases of metals and alloys using phase diagrams.
CO3	Assess the mechanical behaviour of materials according to the standards.
CO4	Recommend suitable heat treatment and surface hardening processes.
CO5	Propose the suitable material based on the structure-property relationships.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

- 1.a) Explain the term 'Materials tetrahedron' in detail. Cite at least two examples of engineering applications demonstrating inter-relation between various aspects of the tetrahedron. CO1 BL3
- OR**
- 1.b) Explain following terms with suitable illustrations and discuss their effects on both strength and ductility of metals: (i) Dislocations and (ii) grain-boundary. CO1 BL3
2. The atomic radii of pure iron and aluminum are 0.124 and 0.143 nm, respectively. Calculate the number of unit cells present in 1 cm³ volume for both the metals. Moreover, calculate the theoretical density of both metals if the gram atomic weights of pure iron and aluminum are 55.845 and 26.98 gm/mol, respectively. CO1 BL4
3. What is isomorphous system? Draw a binary phase diagram for a eutectic isomorphous system. Discuss phase transformation and resultant microstructure at different points during slow cooling of the system for a given composition. CO2 BL3
4. Sketch an ideal iron-iron carbide binary equilibrium diagram, indicating temperature, composition and different phases present. Also, explain all the invariant reactions of this diagram. CO2 BL3
5. Briefly differentiate the terms 'hardness' and 'hardenability'. Explain the most suitable technique to estimate the hardness value of a thin copper sheet in detail. CO3 BL3
6. Why is creep behavior an important consideration in the design of jet engine turbine blades? What are the primary microstructural mechanisms responsible for creep deformation in metals? CO3 BL4

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| 7. | Design appropriate heat-treatment cycles, with their names, for a eutectoid steel for obtaining (i) pearlite and (ii) bainite phases. Sketch the likely appearance of both phases. Also, mention at least two major challenges in attaining bainite phase. | CO4 | BL4 |
| 8. | Compare Gray, Spheroidal, and White cast irons with respect to (i) Composition, (ii) Microstructure, and (iii) Mechanical properties. Also, mention three advantages of cast iron over steel. | CO5 | BL3 |
| 9.a) | Discuss different types of aluminum alloys based on their major alloying elements and respective applications. Explain common strengthening mechanisms for aluminum alloys used in aerospace applications. | CO5 | BL3 |
| OR | | | |
| 9.b) | Define 'ceramic' and discuss the their key characteristics? Discuss the powder metallurgy process with help of a schematic to prepare ceramic components for a given application. | CO5 | BL3 |
| 10. | Define 'polymers'. Discuss the classification of polymers based on their thermal behaviour. Give at least four examples and two applications of each type. Also define the glass transition temperature of a polymer. | CO5 | BL3 |

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