Time: **3** hours   **Max.Marks:80**

NB: 1. **Q.1 is compulsory.**
     2. Solve any **three** from the remaining questions.
     3. All questions carry equal marks

Q.1   Answer **any FOUR**:   (20)

     (a) Difference between steels and cast irons
     (b) Allotropic modifications of iron
     (c) Classification of materials
     (d) Modes of deformation in materials
     (e) Stainless steels and its classification

Q.2   (A)Define critical cooling rate. Describe various cooling curves on TTT diagram for
     eutectoid steel and discuss the transformations.   (10)
     (B)Explain the property and micro-structure changes occurring during cold working
     and recrystallization annealing of metals.   (10)

Q.3   (A)Draw Fe-Fe$_3$C equilibrium diagram and label all the important temperatures,
     composition and phases clearly. Also write the invariant reactions.   (10)
     (B)Describe the cooling of 0.5%C steel to room temperature. Also find out the
     proportion of micro constituents in it at room temperature.   (10)

Q.4   (A) What is fatigue of metals? Explain the method of testing the metals for fatigue.
     Discuss the various methods used to increase fatigue life of a component.   (10)
     (B) What is Hardenability? What are factors affecting hardenability? Explain Jominy
     End Quench test.   (10)

Q.5   (A) How is surface hardening different from case hardening? Discuss any one of the case
     hardening methods in detail.   (10)
     (B) A continuous and aligned fibre-reinforced composite is to be produced consisting of
     30 vol% aramid fibres in polycarbonate matrix. Find the modulus of the compositein
     longitudinal direction.(Given: modulus of elasticity for aramid fibre = 131 GPa
     modulus of elasticity for polycarbonate = 2.4 GPa)   (5)
     (C) What are smart materials? Discuss a few applications for smart materials.   (5)

Q.6   Write short notes on **(Any FOUR):**   (20)

     (a) Nano materials and their synthesis route
     (b) Creep behaviour in metals
     (c) Dislocations and strain hardening
     (d) Isomorphous phase diagram
     (e) Retained austenite
     (f) MR fluids

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