

Time: 3 hours

Total marks :80



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

Q.1 Answer any **four** from the following:

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1. Hume–Rothery gave governing conditions for formation of solid solutions. Discuss the conditions.
2. Discuss the differences between slip and twinning.
3. Why FCC metals are more ductile than BCC and HCP metals?
4. What are nanomaterials? Discuss some of their applications.
5. What are limitations of Plain carbon steel? Explain the effect of alloys on phase transformations.

Q.2

1. Define critical cooling rate. Describe various cooling curves on TTT diagram. What factors affect critical cooling rate? 10
2. Draw Fe-Fe₃C equilibrium diagram and label the temperatures, composition and phases. 10

Q.3

1. Describe the cooling of the eutectoid steel from liquid state to room temperature. Calculate the phases in the pearlite obtained at room temperature. 10
2. Describe the micro-structures for: - (i) White cast iron (ii) Malleable cast iron (iii) Grey cast iron (iv) Nodular cast iron (v) Mild steel 10

Q.4

1. What is strain hardening? Explain the phenomenon on the basis of dislocation theory. 6
2. What is fatigue of metals? Explain the method of testing metals for fatigue. 8
3. Define creep. Draw the creep curve and explain the stages of creep. 6

Q.5

1. Explain critical resolved shear stress (CRSS) and derive an expression for the same. 10
What is the effect of alloying and temperature on the CRSS of any system.
2. What is Hardenability? What are factors affecting hardenability? Explain Jominy End Quench test. 10

Q.6 Answer any **four**-

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1. Discuss the importance of recrystallization annealing.
2. A slowly cooled steel contains 50% ferrite and 50% pearlite at room temperature. Determine the amount of total ferrite and cementite present in the alloy.
3. Calculate the upper bound and lower bound values for density and Young's moduli for a composite made of silicon carbide particles with volume fraction of 0.2 and aluminium matrix. Given that the density of SiC and Al is 3.15 and 2.70 Mg/m³ respectively and their modulus is 420 and 70GPa respectively.
4. What are smart materials? Where are they used?
5. Discuss the principle and practice of Nitriding.
