Name: **Enrolment No:**	

UPES Dehradun

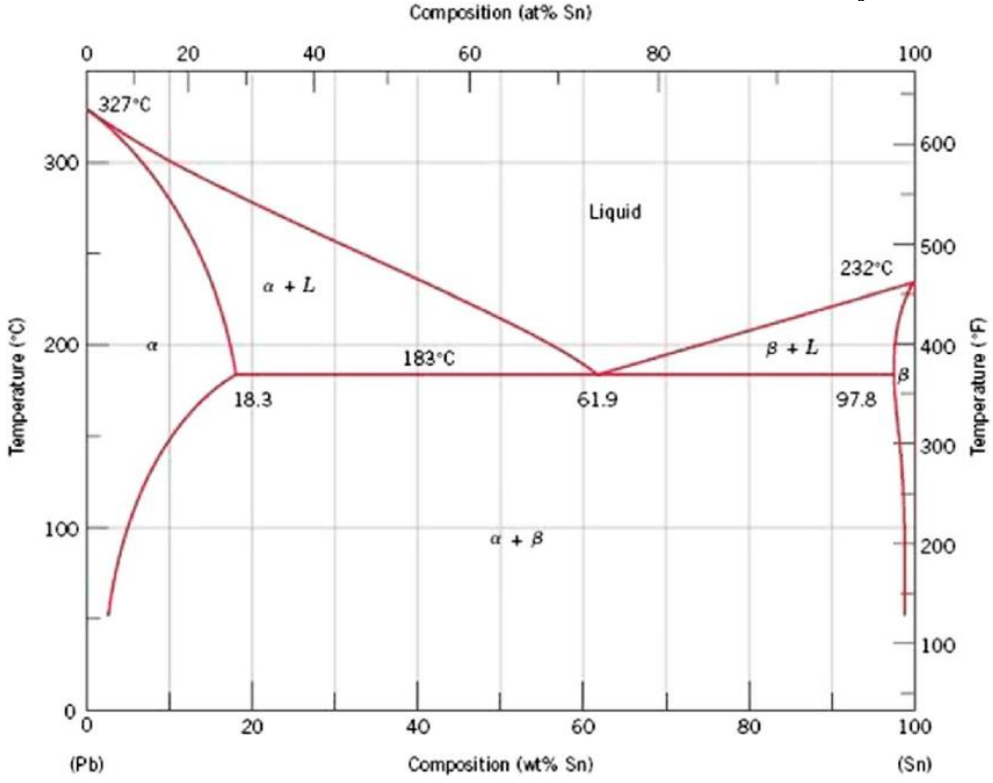
End Semester Examination, December 2024

Programme Name : B. Tech-(Mechanical Engineering and ADE) Semester : III
Course Name : Materials Science Time : 03 hrs.
Course Code : MEMA 2005 Max. Marks : 100
Nos. of page(s) : 2

Instructions: Attempt all questions. One question from sections B and C has an internal Choice. Assume any missing data if required.

SECTION A

S. No.		**Marks**	**CO**
Q1	(a) Draw a neat sketch of the S-N curve for mild steel. (b) Define Hardness.	4	**CO1**
Q2	Sate Hume Rothery,s rules.	4	**CO1**
Q3	Explain substitutional and interstitial solid solutions with suitable examples.	4	**CO2**
Q4	Differentiate between creep and fatigue.	4	**CO3**
Q5	Explain the flame hardening process with a neat sketch.	4	**CO4**
	SECTION B		
Q6	(a) Define homogeneous and heterogeneous nucleation. (b) Distinguish between destructive and non-destructive testing with suitable examples. (c) Remember at least 6 non-destructive testing methods and list them out.	3 4 3	**CO1**
Q7	(i) Define fatigue failure. Neatly sketch the various fatigue loading cycles. (ii) Explain Griffith's theory of brittle fracture.	4 6	**CO2**
Q8	(a) Build an isomorphous phase diagram for a Cu-Ni alloy and label all the points and their important features. (b) Identify the difference between austenite, ferrite, cementite, and pearlite.	6 4	**CO3**
Q9	A. (i) Sketch and explain the working principle of a creep tester. (ii) explain the working principle of a Universal Testing Machine (UTM) Or B Draw the scheme Iron-Iron Carbide phase diagram with all the phases presents.	5 5 10	**CO2**
	SECTION-C		
Q10	(a) Classify the heat treatment process and describe the annealing process. (c) Describe gray cast iron and nodular cast iron. Write their properties and applications.	10 10	**CO3**

Q11	**A.** Analyze the Pb-Sn Phase diagram and answer the following questions: Draw the scheme of microstructure evolution at 60% Pb-40% Sn system.  **B.** A binary alloy having 28 wt % Cu & balance Ag solidifies at 779 ºC. The soild consists of two pahses α & β. Phase α has 9% Cu whereas phase β has 8% Ag at 779ºC. At room temperature, these are pure Ag & Cu respectively. Sketch the phase diagram. Label all fields & lines. Melting points of Cu & Ag are 1083 ºC & 960 ºC respectively. Estimate the amount of α & β in the above alloy at 779 ºC & at room temperature. Or **B.** Construct a phase diagram for the system A-B for the following data: Melting point of A = 1500 ^{o}C Melting point of B = 8000 ^{o}C Eutectic Point = 500 ^{o}C at 40 atomic % B Maximum solubility of A in B at 500 ^{o}C = 10 atomic % Maximum solubility of B in A at 500 ^{o}C = 20 atomic % Limits of solid solution at 300 ^{o}C = 10 atomic % in A, 5 atomic % in B. Label the phase diagram. Calculate fractions of pro eutectoid phase and eutectic mixture at the eutectic temperature for the alloy containing 40 atomic % A. (ii) Make a T-T-T curve for 0.8 wt% eutectoid steel. Mark the areas of coarse perlite, fine perlite, upper bainite, and lower bainite.	10 10 10 10	**CO4**