Name:

Enrolment No:

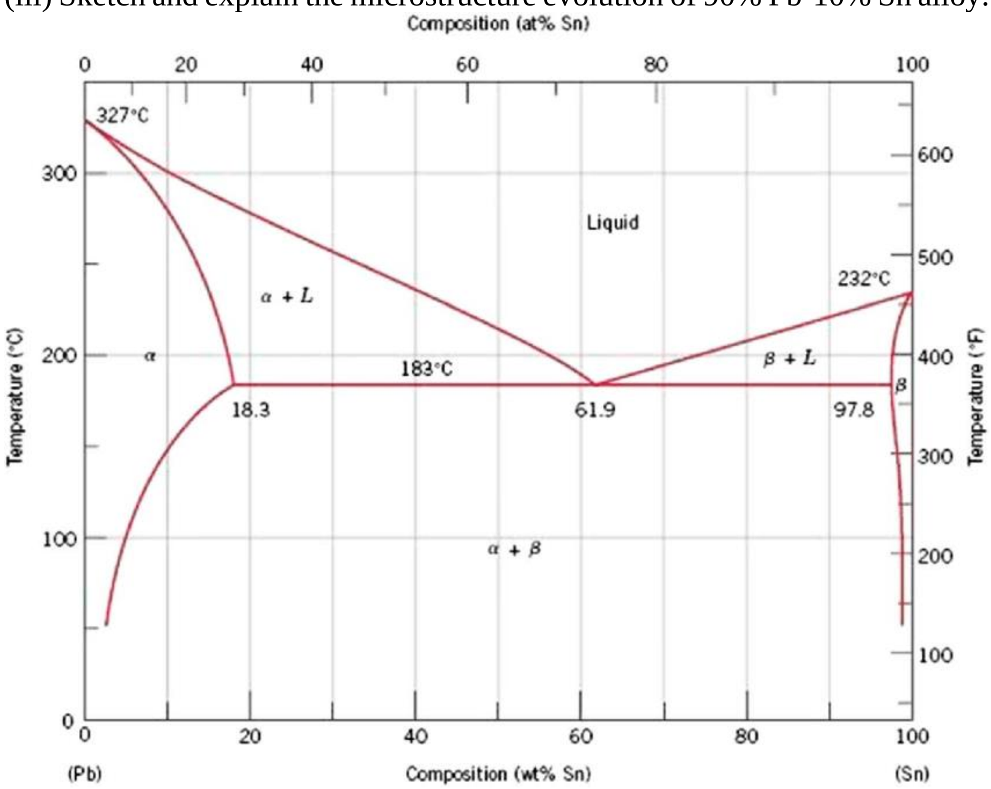
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Supplementary Examination, DEC 2023

Programme Name : B. Tech-Mechanical Engineering Semester : III
Course Name : Material Engineering Time : 03 hrs.
Course Code : MEMA2003 Max. Marks : 100
Nos. of page(s) : 2

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

SECTION A

S. No.		Marks	CO
Q1	(a) Draw neat sketch of S-N curve for mild steel. (b) Define Hardness.	4	**CO1**
Q2	Sate Hume Rothery,s rules and discuss in detail	4	**CO1**
Q3	Draw the scheme of a eutectoid phase diagram of two component system.	4	**CO2**
Q4	Differentiate brittle and ductile fracture with appropriate examples.	4	**CO3**
Q5	Explain flame hardening process with neat sketch.	4	**CO4**
	SECTION B		
Q6	(a) Define homogeneous and heterogeneous nucleation. (b) Write the coordination number for BCC, FCC, and HCP unit cell. (c) Define heat treatment process and mentioned its purposes.	3 3 4	**CO1**
Q7	(a) Explain resilience, yield strength, and ductility. (b) Explain goodman method for combination of stresses.	4 6	**CO2**
Q8	You have a duty to examine a railway wheel after its periodic service. Explain how you will detect the presence of surface cracks and describe the process with a suitable scheme.	6 4	**CO3**
Q9	A (i) Define fatigue failure. Neatly sketch the various fatigue loading cycles. (ii) A fatigue test was conducted in which the mean stress was 70 MPa, and the stress amplitude was 210 MPa. (a) Compute the maximum and minimum stress levels. (b) Compute the stress ratio. (c) Compute the magnitude of the stress range. Or B (i) Illustrate the process of measuring endurance limit for structural materials. (ii) Explain with neat sketches the two modes of fracture failure of metal.	5 5 5 5	**CO2**

SECTION-C			
Q10	(i) Construct a phase diagram for the system A-B for the following data: Melting point of A = 1000 ^oC Melting point of B = 8000 ^oC Eutectic Point = 500 ^oC at 40 atomic % B Maximum solubility of A in B at 500 ^oC = 10 atomic % Maximum solubility of B in A at 500 ^oC = 20 atomic % Limits of solid solution at 300 ^oC = 10 atomic % in A, 5 atomic % in B Label the phase diagram. Calculate fractions of proeutectoid phase and eutectic mixture at the eutectic temperature for the alloy containing 25 atomic % B. (ii) Draw tin-lead equilibrium diagram. If, for soldering, 85% eutectic mixture is preferred, determine the composition limits of tin that will satisfy this condition	15 5	**CO3**
Q11	**A.** Analyze the Pb-Sn Phase diagram and answer the following questions: (i) Write the solubility limit and temperature of eutectic composition. (ii) Write the invariant reaction with phase composition. (iii) Sketch and explain the microstructure evolution of 90% Pb-10% Sn alloy.  **B.** Develop the microstructure evaluation of Pb-Sn alloy at eutectic composition with its phase composition and relative amount of phase present. Or	 2 2 10 6	**CO4**

	B. (i) 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. (ii) Discuss how you will design a sord having hard surface and toughen core.	15 5	