SLOT: B2+TB2

REG.NO.: 24BME0232

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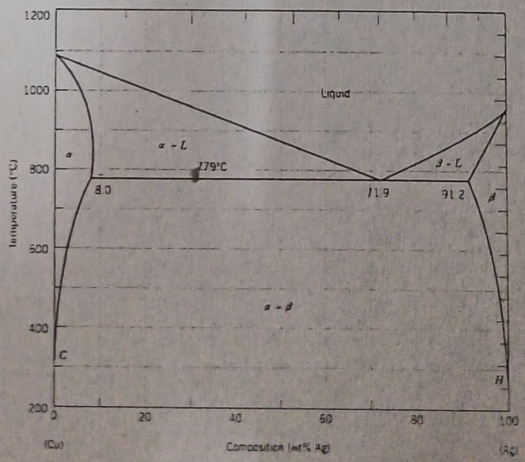
SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -II
FALL SEMESTER 2025-2026

Programme Name & Branch	: B.Tech - Mechanical Engineering
Course Code	: BMEE209L
Course Name	: Materials Science & Engineering
Faculty Name(s)	: Dr. Ariful Rahaman, Dr. Ashish Kumar, Dr. Kishore Kumar Mahato, Dr. Yazar K.U., Dr. Vivek Kumar Barnwal, Dr. Mahesh V.P.
Class Number(s)	: VL2025260107377; VL2025260102900; VL2025260102144; VL2025260102909; VL2025260102143; VL2025260102916
Date of Examination	:06/10/2025
Exam Duration	: 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- For Question 3: Use Fig. 3 and attach this page with answer sheet
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes Statements:
- CO. 2: Examine various phases of metals and alloys using phase diagrams
- CO. 3: Assess the mechanical behaviour of materials according to the standards
- CO. 4: Recommend suitable heat treatment and surface hardening processes

Q. No	Question	M	CO	BL
1.	The copper silver (Cu-Ag) phase diagram is given below in Fig 1, a)Determine: i) the melting temperature of pure Ag and Cu. ii) the eutectic temperature and eutectic composition. iii)the maximum solubility of Cu in Ag and maximum solubility of Ag in Cu. b) Consider a 30 wt% Ag-70wt% Cu alloy. At the temperature T=780°C determine: i) the phase or phases present ii) the composition of each phase iii) the weight fraction of each phase present, and iv) sketch a possible microstructure  Fig. 1	10	2	4

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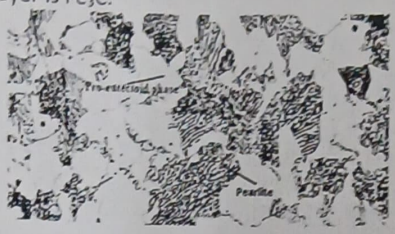
2.	Following is a micrograph of steel, the lighter phase is α ferrite and the darker layer is Fe_3C.  Fig. 2 Is it a eutectoid, hypoeutectoid or hypereutectoid steel? Assuming the weight fraction of proeutectoid phase to be 0.6, determine the composition of the steel. What is the upper critical transformation temperature (approximate) and lower critical transformation temperature of the given steel?	10	2	4
3.	Using the T-T-T diagram **(Fig.3)** for eutectoid steel, draw the specified cooling path on the diagram. Indicate what phases you expect in the final product with percentage of each phase. Assume the material has been fully austenitized before cooling. i) Rapidly cool to 540°C, hold for 100 seconds, then quench to room temperature ii) Rapidly cool to 550°C, hold for 6 seconds, then quench to room temperature iii) Rapidly cool to 300°C, hold for 15 minutes, then quench to room temperature iv) Rapidly cool to 650°C, hold for 10^4 seconds, then quench to room temperature. v) Rapidly cool to 560°C, hold for 10^3 seconds, then quench to room temperature. vi) Draw and explain the difference between the microstructures and tensile strength of (iv) and (v).	10	3	4
4.	a) What are the objectives of heat treatment of steel? Discuss the differences in the microstructure of hypoeutectoid steel (0.5 % C) and hyper eutectoid steel (1.1 % C) in annealed condition with the help of schematic drawings. (5 marks) b) If a piece of steel having 0.2% carbon is quenched after soaking at a temperature just above eutectoid temperature what type of structure will you get? Calculate the approximate amount of phases present and their compositions. (5 marks)	10	4	4
5.	Explain the principle of surface hardening of steel and why it is important. Compare and contrast carburizing and nitriding as surface hardening methods in terms of process, temperature, and final microstructure.	10	4	3

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