Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST – II
FALL SEMESTER 2023-2024

SLOT: B1+TB1

Programme Name & Branch	:	B.Tech. Mechanical Engineering
Course Code	:	BMEE209L
Course Name	:	Materials Science and Engineering
Faculty Name(s)	:	Dr. Devendranath Ramkumar, Dr. Ahankari Sandeep S, Dr. Chinmaya Prasad Mohanty, Dr. Ashish Kumar, Dr. Mahesh VP, Dr. Kishore Kumar Mahato
Class Number(s)	:	VL2023240101652, VL2023240101656, VL2023240101655, VL2023240101668, VL2023240101667, VL2023240101654

Exam Duration: 90 minutes **Maximum Marks: 50**

General instruction(s): Answer **all** the questions.

Q. No.	Question	Marks
1.	(a) Draw and discuss the phase diagram involving two metallic elements used in soldering which have restricted solid solubility in each other and form terminal solid solutions with a suitable example. Explain the significance of the various lines appearing in the phase diagram.	07
	(b) Calculate the amount of each phase present in 1 kg of a 50 wt.% of each constituent in the aforementioned phase diagram at a) 300°C, b) 200°C and c) 100°C.	03
2.	Bring out the differences between Athermal and isothermal transformation. Debate with the use of one heat treatment in each to understand these transformations in detail with suitable reaction diagrams and reaction product.	10
3.	Using the isothermal transformation diagram for an iron–carbon alloy of eutectoid composition, specify the nature of the final microstructure (in terms of micro-constituents present and approximate percentages of each) of a small specimen that has been subjected to the following time–temperature treatments. In each case, assume that the specimen begins at 760 °C and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure. i. Cool rapidly to 350 °C, hold for 10^3 s, then quench to room temperature. ii. Rapidly cool to 625 °C, hold for 10 s, then quench to room temperature. iii. Rapidly cool to 600°C, hold for 4 s, rapidly cool to 450°C, hold for 10 s, then quench to room temperature. iv. Reheat the specimen in part (iii) to 700 °C for 20 h. v. Rapidly cool to 300 °C, hold for 20 s, then quench to room temperature in water. Reheat to 425 °C for 10^3 s and slowly cool to room temperature. vi. Cool rapidly to 665 °C, hold for 10^3 s, then quench to room temperature. vii. Rapidly cool to 575 °C, hold for 20 s, rapidly cool to 350 °C, hold for 100 s, then quench to room temperature. viii. Rapidly cool to 350 °C, hold for 150 s, then quench to room temperature.	10

	ix. Sketch and label time–temperature paths on this diagram to produce the following microstructures - 50% coarse pearlite, 25% bainite, and 25% martensite.	
4.	(a) Why globular cementite is more preferred for the cutting tools? Explain the heat treatment methodologies involved in obtaining the globular cementite in the high carbon steels with suitable illustrations.	06
	(b) Explain why thicker sections are more susceptible to cracking during hardening heat treatment.	04
5.	Answer the following questions related to case hardening of low carbon steels. i. Cite three main reasons for surface hardening of steel. ii. Can steel having 0.1% carbon be case carburized at 850^{0}C? iii. What is the white layer on steel that forms during nitriding? iv. Bring out the differences between liquid carburizing and cyaniding?	10

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