

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: B. TECH
BRANCH: PIE & ME

SEMESTER : III
SESSION : MO/2025

SUBJECT: PE24201 INTRODUCTION TO MATERIALS ENGINEERING

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:

1. The question paper contains 5 questions, each of 5 marks and a total of 25 marks.
 2. Attempt all questions. 3. The missing data, if any, may be assumed suitably.
 4. Tables/Data handbook/Graph paper, etc., if applicable, will be supplied to the candidates
-

Q.1	I. Explain the statement - 'Polymers are usually insulators while metals are electrical and thermal conductors'	[1]	CO1	BL2
	II. Determine the number of atoms in a unit cell of the FCC Bravais lattice with a diagram. Derive the atomic packing fraction for the FCC system.	[2]	CO1	BL3
	III. State the primary differences between a crystal system and a crystal structure.	[1]	CO1	BL1
	IV. Justify with logical reasoning whether a 100% perfect crystal or a crystal with 1% vacant sites is more stable.	[1]	CO1	BL5
Q.2	I. Define a Frenkel defect in an ionic crystal with the help of a neat diagram. Such a defect cannot be present in metals - Justify with logical reasoning.	[2]	CO1	BL5
	II. State the main steps of phase identification by XRD.	[1]	CO1	BL1
	III. Identify the role of the vacuum in SEM and TEM machines.	[1]	CO1	BL2
	IV. Justify the statement - 'A dislocation cannot be detected under an optical microscope while a grain boundary is easily identified'	[1]	CO1	BL5
Q.3	I. Draw the temperature versus time curve depicting the melting of a pure solid metal. Apply the Gibbs phase rule to determine the degrees of freedom in the different regions of the curve.	[2]	CO2	BL5
	II. Air is a mixture, while sugar syrup is a solution - Differentiate between the two with suitable logic.	[1]	CO2	BL5
	III. Can four distinct phases coexist in the microstructure of a binary alloy at one atmospheric pressure? Explain with the help of a suitable principle.	[1]	CO2	BL3
	IV. Draw a schematic binary isomorphous phase diagram and explain how the relative amounts of solid and liquid phases can be estimated at a temperature between the melting points of pure A and pure B.	[1]	CO2	BL3
Q.4	I. Define diffusion and the driving force for diffusion in metallic solids.	[2]	CO2	BL4
	II. Differentiate between specific heat and heat capacity.	[1]	CO2	BL2
	III. Define an invariant point. Determine the number of invariant points possible in a binary eutectic phase diagram with the help of a neat diagram with partial solubility of A in B, but no solubility of B in A.	[2]	CO2	BL3
Q.5	I. Sketch and label the Fe-Fe ₃ C binary phase diagram depicting the phases, phase fields, invariant reactions and concerned temperatures.	[2]	CO2	BL3
	II. Identify any two main limitations of plain carbon steel.	[1]	CO2	BL2
	III. Explain how a pure metal can be strengthened without alloying.	[1]	CO2	BL3
	IV. Name at least one major application of the non-ferrous alloys based on (i) Al, (ii) Cu, and (iii) Ti	[1]	CO2	BL1