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

CLASS: B. Tech **SEMESTER : III/ADD**
BRANCH: MECH/PIE **SESSION : MO/2024**

SUBJECT: PE214 METALLURGICAL AND MATERIALS ENGINEERING

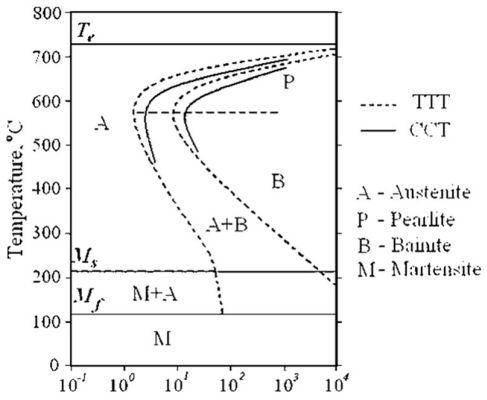
TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks totalling 50 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**

				CO	BL
Q.1(a)	I.	Define unit cell and name the characteristic parameters necessary to define a unit cell sufficiently. Why is hexagonal close packed not included among the 14 Bravais lattices and name the crystal lattice it is based on.	[1+1+ 1+2]	CO1	BL3 BL4
	II.	Ionic solids generally possess lower density than metals – Justify the statement with a proper argument.			BL3
	III.	Draw a schematic unit cell of diamond cubic structure, identify the Bravais lattice, and calculate the total number of atoms per unit cell.			
Q.1(b)	I.	Define 'family of planes' by stating the property common among them. State the planes which will include all the planes for the (100) family of planes.	[1+2 +2]	CO1	BL2 BL3
	II.	Classify macroscopic mechanical forces. Distinguish between the processes of extrusion and drawing on the basis of the forces acting.			BL4
	III.	To increase the life of a gear tooth, the surface needs to be harder, more wear resistant with the core being tougher. Name and briefly state the mechanism of any one surface engineering technique that can ensure such design requirement to ensure graded microstructure, functionality and composition across the diameter or thickness.			
Q.2(a)	I.	State the thermodynamic conditions for forming an ideal solutions.	[1+2 +2]	CO2	BL2 BL3
	II.	Calculate the number of phases that should coexist for a ternary non-condensed system to exist in an invariant condition. Will the answer be different for a condensed system and why?			BL2
	III.	State the condition that allows the formation of an isomorphous binary alloy. Draw and label all phase fields of an isomorphous binary phase diagram.			
Q.2(b)	I.	Differentiate between allotropism and polymorphism and give any one example of allotropism in metals or ceramics.	[2+2 +1]	CO2	BL2 BL1
	II.	Draw the following schematic binary phase diagrams and label the phase fields showing the: (a) eutectic and (b) monotectic transformations.			BL4
	III.	Choose an isothermal temperature above the eutectic temperature and indicate the relative volume fractions of the phases for any two hypo and hyper-eutectic alloys at that reference temperature using the Lever Rule.			

PTO

Q.3(a)	I.	In the adjacent sketch, the TTT diagram of a steel is a complete C-curve while the corresponding CCT diagram is a half C-curve – briefly explain the reasons for such an appearance with proper reasoning.	[3+1+1]	CO3	BL3
	II.	Referring to this TTT-diagram, only name the heat treatment that can ensure complete bainitic microstructure in steel.			BL2
	III.	State the hazards of liquid bath carburizing and nitriding.			BL1
Q.3(b)	I.	The upper critical temperature of 0.6 wt.% plain C steel is approximately 800 °C. Select a temperature for a muffle furnace to be utilized to heat the steel to carry out annealing heat treatment.	[1+2+2]	CO3	BL3
	II.	Average grain size after normalizing of a steel is always smaller than that after annealing – briefly state why.			BL2
	III.	Define hardenability of steel just in one line or phrase. Why is Jominy method of determination of hardenability of steel more easy to practice than the Grossman method?			BL2
Q.4(a)	I.	Name the stages of annealing of a cold worked metallic alloy and the driving forces associated with them.	[2+1+1+1]	CO4	BL3
	II.	Name any two major applications of ceramic solids.			BL2
	III.	What is a superalloy? Name the major classes of superalloys.			BL1
	IV.	Name the technology for sheet glass production and state the physical properties that ensures smooth surface finish.			BL3
Q.4(b)	I.	What is visco-elasticity? Why only polymers show such a property at room temperature, but metals do not?	[2+1+2]	CO4	BL3
	II.	Name the most important and common processing routes of ceramics.			BL1
	III.	State the difference between thermoplastic and thermosetting polymers. Why does vulcanization improve mechanical properties including creep strength of rubber-based automobile tyres?			BL3
Q.5(a)	I.	State the basis of differentiation between Rockwell A, B, and C scales of hardness.	[1+2+2]	CO5	BL2
	II.	Draw the tensile test specimen and explain the reasons for selecting such a shape in comparison to a cylindrical rod of uniform diameter.			BL3
	III.	Areas under only the elastic region and the entire elastic and plastic region of the stress-strain curve represent the _____ and _____ properties of the material.			BL1
Q.5(b)	I.	Differentiate between soft and hard magnets with the help of a neat magnetic moment as a function of field strength curve and mark the coercivity and retentivity points on them.	[2+1+2]	CO5	BL2
	II.	State the most important difference between extrinsic and intrinsic properties. Name the two possible ways of changing the band gap of an intrinsic semi-conductor.			BL1
	III.	Name four major types of corrosion.			BL1



:::::22/11/2024 E:::::