Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / (Full Time) - END SEMESTER EXAMINATIONS, APRIL/MAY 2024

(COMMON TO MANUFACTURING, INDUSTRIAL, MINING, AERONAUTICAL, AUTOMOBILE, RPT AND PRODUCTION ENGINEERING)

II SEMESTER

PH5251- MATERIALS SCIENCE

(Regulation 2019)

Time: 3 hours **(Answer all questions)** **Max.Marks:** 100

CO 1	Understand the basics of crystallography and its importance in materials properties
CO 2	Understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
CO 3	Gain knowledge on binary phase diagrams, and also will be able to determine the phase composition and phase amount.
CO 4	Understand about the Fe-C system and various microstructures in it, and also about various ferrous and non-ferrous alloys.
CO 5	Get adequate understanding on the preparation, properties and applications of ceramics, composites and nanomaterials

BL - Bloom's Taxonomy

Levels (L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analyzing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)

Q. No	QUESTIONS	Marks	CO	BL
1.	Sketch the atomic packing of (101) and (111) planes for the FCC crystal structure.	2	1	L3
2.	Define polymorphism with an example	2	1	L1
3.	List major differences between twinning mechanism and deformation by slip in materials.	2	2	L3
4.	Specify the conditions under which creep occurs in solid materials.	2	2	L4
5.	Differentiate isomorphous system and eutectic system with an example.	2	3	L4
6.	Express the criteria for the number of phases in a metal alloy system which is at equilibrium.	2	3	L5
7.	Compare the mechanical properties of pure copper with their alloys.	2	4	L3
8.	Which is more stable, the austenitic or the spheroiditic microstructure? Why?	2	4	L5
9.	What are carbon-carbon composites?	2	5	L1
10.	State the principle of transmission electron microscopy.	2	5	L2

PART- B (5x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11(a)	i. Derive linear density and planar density expressions for BCC (100) and (110) and (111) planes in terms of the atomic radius. ii. Derive the atomic packing factor for HCP structure.	9 4	1	L3
	OR			
11(b)	i. Explain edge and screw dislocation motions and cite the relative Burgers vector–dislocation line orientations for edge, screw, and mixed dislocations. ii. Brief the kinetics of phase transformations.	9 4	1	L3

12(a)	i. Explain elastic and plastic deformations by plotting a stress–strain curve and define modulus of elasticity proportional limit, yield strength and tensile strength of brittle and ductile materials. ii. Write notes on slip systems with examples.	9 4	2	L4
	OR			
12(b)	i. Derive the Griffiths equation and detail the Griffith Theory of Brittle Fracture. Explain the fracture of ductile materials. ii. Explain the mechanism of creep and a creep plot for some material with respect to loading time.	9 4	2	L4
13(a)	i. Construct a phase Diagram of Cu-Ni alloy of some composition is slowly heated from a temperature of 1300°C (2370°F), and that is at equilibrium and explain the phases present - from the location of the temperature - composition point on the phase diagram and phase composition for the two-phase situation by employing a horizontal tie line. ii. Write the invariant reactions involved in the Pb-Sn phase diagram for either heating or cooling.	9 4	3	L4
	OR			
13(b)	i. Construct a phase Diagram of Pb (30 wt %) - Sn (70 wt %) alloy which is at equilibrium, and explain the microstuctural changes involved during cooling. ii. Differentiate hypoeutectic and hypereutectic components in steel alloys.	9 4	3	L4
14(a)	i. For a given composition of a Fe-FeC alloy containing between 0.022 wt% C and 2.14 wt% C. Construct a phase diagram and explain the microstructural changes involved during cooling. ii. List titanium alloys with its composition and give its properties.	9 4	4	L5
	OR			
14(b)	i. Construct an isothermal transformation (T-T-T) diagram for eutectoid steel and explain pearlitic, bainitic, and martensitic transformations. ii. What is the function of alloying elements in steels? Give examples.	9 4	4	L5
15(a)	i. What are the advantages of composites over engineering alloys? Classify composites and explain the role of matrix and fiber in fiber reinforced composites. ii. What are ceramics? Classify ceramics based on their functionality.	9 4	5	L1
	OR			
15(b)	i. Explain carbon nanotubes and mention their properties and applications. ii. Explain the synthesis of nanomaterials using chemical vapour deposition (CVD) method.	9 4	5	L1

PART- C (1 x 15 = 15 Marks)

Q. No	Questions	Marks	CO	BL
16	i. Describe the strengthening mechanisms and explain how dislocations are involved in each of the strengthening techniques. ii. Explain the instrumentation and working of scanning electron microscopy with a neat sketch.	9 6	2/5	L2