

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2022****Subject Code:3142109****Date:08-07-2022****Subject Name:Physical Metallurgy****Time:10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		<b>MARKS</b>
<b>Q.1</b>	(a) Define: Phase, components, degree of freedom.	<b>03</b>
	(b) FCC metals have more packing density than BCC crystal yet why solubility of carbon in FCC form of iron is higher than in its BCC form? Explain it by cut section of FCC and BCC.	<b>04</b>
	(c) Draw the Fe-Fe <sub>3</sub> C diagram with all temperatures, phases and invariant reactions.	<b>07</b>
<b>Q.2</b>	(a) Draw the microstructure of mechanical mixture. Explain the characteristic of each phase. Give its examples.	<b>03</b>
	(b) What is the difference between limited and unlimited solid solubility? Give its example.	<b>04</b>
	(c) Briefly state the Hume-Rothery rules and explain the rationale.	<b>07</b>
<b>OR</b>		
(c)	Two metals A (melting point 800 °C) and B (melting point 600 °C) form a binary isomorphous system. An alloy having 35% B has 75% solid and rest liquid whereas an alloy having 55%B has 25% solid at 700 °C. Estimate the composition of solidus and liquidus at the above temperature.	<b>07</b>
<b>Q.3</b>	(a) Determine the degree of freedom for binary alloy having no. of phases present P= 1, 2 & 3. What we call each system?	<b>03</b>
	(b) What is a binary phase diagram and what information can be learned from it? In terms of thermodynamics, what is meant by the term “equilibrium phase diagram”?	<b>04</b>
	(c) By cooling curve, draw the solidus and liquidus for Isomorphous phase diagram and explain the significance of the solidus curve and liquidus curve.	<b>07</b>
<b>OR</b>		
<b>Q.3</b>	(a) When the Laves phase are formed? What is the stoichiometry formula of it?	<b>03</b>
	(b) Draw the graph for RN and RG versus temperature and explain the same.	<b>04</b>
	(c) The mass fractions of total ferrite and total cementite in an iron-carbon alloy are 0.88 and 0.12, respectively. Is this a hypoeutectoid or hypereutectoid alloy? Why?	<b>07</b>
<b>Q.4</b>	(a) What do you mean by electron compound? Give some example.	<b>03</b>
	(b) By thermodynamics, explain the degree of undercooling. What is the significance of it in nucleation?	<b>04</b>
	(c) Derive the formula for the critical radius and critical free energy for homogeneous nucleation.	<b>07</b>
<b>OR</b>		
<b>Q.4</b>	(a) List the three copper and aluminum based alloys.	<b>03</b>
	(b) Depending upon the heating and cooling medium, list the various heat treatment for steel.	<b>04</b>

- (c) Calculate the size of the critical radius and the no. of Cu atoms in critical nucleus when solid Cu forms by homogeneous nucleation. The freezing temperature for Cu is 1085 °C, the heat of fusion is 1628 J/cm<sup>3</sup>, the solid-liquid interfacial energy is  $-177 \times 10^{-7}$  J/cm<sup>2</sup>, and the typical undercooling for homogeneous nucleation is  $\Delta T = 236$  °C. Cu is FCC with the lattice parameter of 0.3615nm. **07**
- Q.5** (a) What is the effect severity of quenching media on austenite upon cooling at room temperature? **03**
- (b) Draw the TTT diagram for eutectoid steel. **04**
- (c) Explain the phase diagram for two metals completely soluble in the liquid state but completely insoluble in solid state. **07**
- OR**
- Q.5** (a) Classify the Superalloys. **03**
- (b) What are the objectives of performing heat treatment? **04**
- (c) List the different types of cast irons. Explain the properties, applications and microstructure of grey cast iron and ductile cast iron. **07**

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