

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023****Subject Code:3142109****Date:25-07-2023****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.

		MARKS
Q.1	(a) What is the system? What do we call the two-component system? Give two examples of it.	03
	(b) What do you mean by alloy? What kinds of structures can be formed when an alloy is solidified from a liquid state?	04
	(c) Sketch the Fe-Fe ₃ C diagram and label it. Show all invariant reactions in it. Draw the microstructure at 0.8 wt. % carbon.	07
Q.2	(a) What is the chemical formula of Laves phase? When Laves phases formed?	03
	(b) What do you mean by intermediate phases? When intermediate phases are formed? Classify the intermediate phases based on compounds.	04
	(c) What is a degree of freedom? How degree of freedom plays a role in the phase diagram? Explain it by Gibbs' phase rule.	07
	OR	
	(c) Draw the cooling curve for pure metal and binary solid solution. Explain Gibbs' phase rule in both cases.	07
Q.3	(a) What is Ferrite?	03
	(b) What is allotropy or polymorphism? Show the allotropy of iron.	04
	(c) Why FCC iron can accommodate more carbon compared to BCC iron though the atomic packing factor of FCC iron is more? Explain.	07
	OR	
Q.3	(a) What is the minimum separable distance between features that can be resolved by a microscope using the flight of 500 nm wavelength, having a refractive index of the lens is 1.9 and an aperture angle of 150°?	03
	(b) For binary systems, A & B, a solid of 68% A (32% B) co-exists with a liquid of 18% A (82% B). The overall composition is 38%, find the fraction of solid.	04
	(c) With the help of the Fe-Fe ₃ C diagram, show a schematic representation of the microstructural changes which occur during slow cooling of 0.4% steel.	07
Q.4	(a) What do you mean by chromatic aberration? How it can be corrected?	03
	(b) 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?	04

- (c) Derive the formula for the critical radius and critical free energy for homogeneous nucleation. **07**

OR

- Q.4** (a) Draw the phase diagram for the isomorphous system. **03**
(b) Write the reaction for eutectic, peritectic, monotectic, eutectoid and peritectoid reactions. **04**
(c) Calculate the size of the critical radius and the no. of Cu atoms in the critical nucleus when solid Cu forms by homogeneous nucleation. The freezing temperature for Cu is 1085 °C, the heat of fusion is 1628 J/cm³, the solid-liquid interfacial energy is -177×10^{-7} J/cm², 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) Draw the Miller indices planes: **03**
(0 1 1); (3 2 1); ($\bar{1} \bar{1} \bar{1}$)
(b) What is the difference between annealing and normalizing? **04**
(c) Write the metallographic sample preparation procedure for preparing the 0.4% C steel. **07**

OR

- Q.5** (a) Classify the important ferrous alloys. **03**
(b) What do you mean by hardenability? Which test is performed to check the hardenability of steel? **04**
(c) List the strengthening mechanisms. Discuss any one mechanism briefly. **07**
