

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2021****Subject Code:3142109****Date:04/09/2021****Subject Name:Physical Metallurgy****Time:02:30 PM TO 05:00 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
<b>Q.1</b>	(a) Define phase. What kind of changes may take place in material while changing in the phase?	<b>03</b>
	(b) On what factors does the relationship between structure and property depend?	<b>04</b>
	(c) Draw the Fe-Fe <sub>3</sub> C diagram neatly and show all labels, reactions, temperature, and compositions on a diagram.	<b>07</b>
<b>Q.2</b>	(a) What do you mean by an alloy? Give two examples of it.	<b>03</b>
	(b) How the mechanical mixture is formed when the metal gets solidified? Also, draw a microstructure of it.	<b>04</b>
	(c) Explain the concept of supercooling by drawing a cooling curve for pure metals. Derive the formula for the rate of nucleation and critical radius.	<b>07</b>
<b>OR</b>		
	(c) Explain the factors governing the substitutional solubility. What is the name of the well-known rule?	<b>07</b>
<b>Q.3</b>	(a) Give any two differences between interstitial solid solution and substitutional solid solution.	<b>03</b>
	(b) Why grain boundaries are the favorable site for the nucleation or growth of precipitates?	<b>04</b>
	(c) Write a note on any one strengthening mechanism.	<b>07</b>
<b>OR</b>		
<b>Q.3</b>	(a) Derive the atomic packing factor for BCC structure.	<b>03</b>
	(b) Draw and show the difference in the microstructures formed after annealing and normalizing.	<b>04</b>
	(c) Construct the phase diagram of isomorphous by using cooling curves.	<b>07</b>
<b>Q.4</b>	(a) Draw the allotropy of the Iron. What is the curie temperature for Iron and cementite?	<b>03</b>
	(b) Draw the graph for the rate of nucleation and rate of growth versus temperature and explain it briefly.	<b>04</b>
	(c) What are the steps for performing metallography? Write the name of etchants for steel.	<b>07</b>
<b>OR</b>		
<b>Q.4</b>	(a) Why the tempering of the hardened steel is to be carried out?	<b>03</b>
	(b) By Fe-Fe <sub>3</sub> C diagram, show the temperature ranges for heat treatment processes for hypo, hyper and eutectoid steels.	<b>04</b>

(c) Draw the ray diagram of the metallurgical microscope for bright field illumination. Explain the terms like resolution, numerical aperture, and magnification. **07**

**Q.5** (a) Draw the crystal planes of the following: **03**  
 $(1\ 2\ 3)$ ;  $(\bar{1}\ \bar{2}\ \bar{2})$ ;  $(1\ 0\ 1)$

(b) Describe the crystal system as per the lattice parameter. **04**

(c) Write a short note on the effect of the addition of alloying elements to the steel. **07**

**OR**

**Q.5** (a) Classify the stainless steel. **03**

(b) Show the liquidus line, solidus line, solvus line, and eutectic in a phase diagram. **04**

(c) Describe any two cast irons with composition, microstructure, and applications. **07**

\*\*\*\*\*