GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– III (New) EXAMINATION – WINTER 2019

Subject Code: 3131904   **Date: 28/11/2019**

Subject Name: Material Science and 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.**

			Marks
Q.1	**(a)**	What is unit cell.	**03**
	(b)	Explain any two mechanical properties.	**04**
	(c)	Do the detailed classification of engineering material.	**07**
Q.2	**(a)**	Grain boundary is a defect. Evaluate.	**03**
	(b)	Explain the importance of undercooling in nucleation.	**04**
	(c)	Explain the final solidification structure of a pure metal ingot.	**07**
		OR	
	(c)	Explain homogeneous and heterogeneous nucleation process with neat sketch.	**07**
Q.3	**(a)**	Describe applications of phase diagram.	**03**
	(b)	Eutectic alloys solidify at fixed temperature. Justify with the help of Gibbs Phase rule.	**04**
	(c)	What is the purpose of hardening? Explain induction hardening in detail.	**07**
		OR	
Q.3	**(a)**	Explain interstitial solid solution.	**03**
	(b)	Explain Hume Rothary rule for substitutional solid solution	**04**
	(c)	Explain the detail procedure of polishing the specimen for microexamination.	**07**
Q.4	**(a)**	What is the role of etchant in microexamination?	**03**
	(b)	Explain the principle of magnetic particle test with neat sketch.	**04**
	(c)	Draw and lable Iron – Iron Carbide diagram. Also explain the reactions taking place in it.	**07**
		OR	
Q.4	**(a)**	Differentiate between Eutectic and Eutectoid reaction.	**03**
	(b)	What are the limitations and capabilities of LPT.	**04**
	(c)	Explain the advantages and disadvantages of powder metallurgy.	**07**
Q.5	**(a)**	What is martensite?	**03**
	(b)	Differentiate between annealing and normalizing	**04**
	(c)	Explain Jominy Hardenability test with neat sketch.	**07**
		OR	
Q.5	**(a)**	Why cast iron has a limited engineering applications?	**03**
	(b)	Explain macro and micro examination.	**04**
	(c)	Explain the mechanism of corrosion. Also explain any one corrosion prevention technique in detail.	**07**

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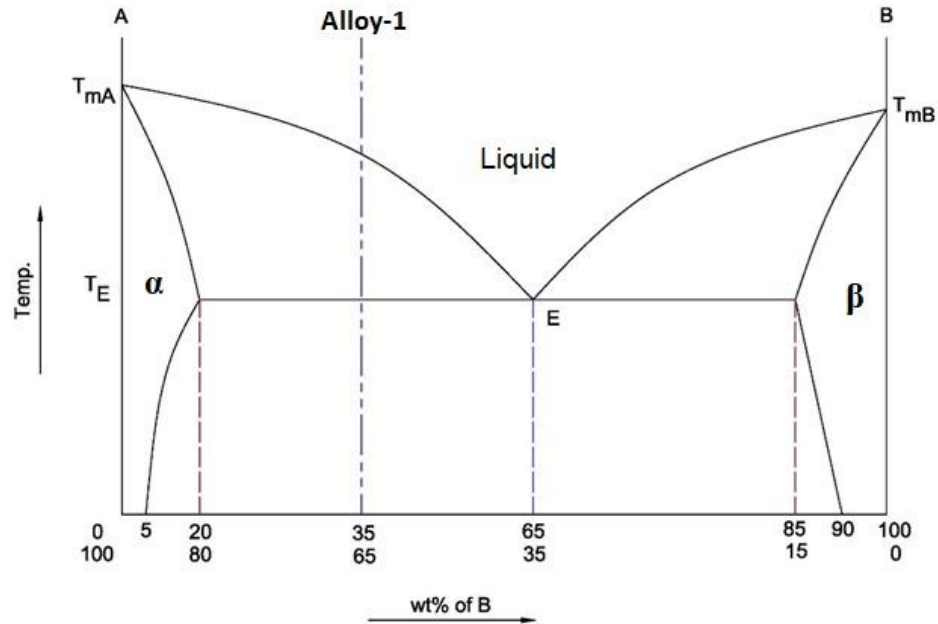
GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2020

Subject Code:3131904   **Date:10/03/2021**

Subject Name:Material Science and Metallurgy

Time:10:30 AM TO 12:30 PM   **Total Marks:56**

Instructions:
1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

			Marks
Q.1	**(a)**	An industry is fabricating stainless steel pressure vessel for nuclear power plant steam generator. The butt welded joint of vessel is inspected by RT. Explain why LPT, MPT and UT cannot be performed.	**03**
	(b)	Draw Miller indices for planes (0 1 1), (1 0 0), (1 1 1) and (1 $\bar{1}$ 0).	**04**
	(c)	Explain solid state transformation from single phase austenitic temperature to room temperature for 0.2% carbon steel and draw room temperature microstructure showing relative percentage of phases present in it.	**07**
Q.2	**(a)**	Justify that grain boundary is a crystalline imperfection.	**03**
	(b)	Explain Austenite to Pearlite transformation for eutectoid steel.	**04**
	(c)	Describe sample preparation technique for microscopic examination.	**07**
Q.3	**(a)**	Outline major mechanical property requirements of bicycle wheel axle.	**03**
	(b)	Describe Magnetic Particle Test principle and advantages.	**04**
	(c)	List powder making process and describe atomization process with help of neat sketch.	**07**
Q.4	**(a)**	Outline optical property requirements of window glass in very hot and sunny region.	**03**
	(b)	Describe Ultarsonic Test principle and advantages.	**04**
	(c)	Outline the process of making powder metallurgy products in brief and discuss advantages of powder metallurgy.	**07**
Q.5	**(a)**	Define Heat Treatment and classify heat treatment processes.	**03**
	(b)	Differentiate Galvanic corrosion and Electrochemical corrosion.	**04**
	(c)	With proper justification choose appropriate heat treatment process for gear used in gearbox of car and explain the selected heat treatment process in detail.	**07**
Q.6	**(a)**	Define hardenability and list three factors affecting it.	**03**
	(b)	Identify role of sacrificial anode by appropriate example in corrosion prevention.	**04**
	(c)	Choose and explain appropriate heat treatment process to be performed on cold rolled steel plate for further manufacturing easiness.	**07**

Q.7 (a) Calculate % of phases present at T_E temperature and room temperature for alloy-1 shown in **Figure-1** using lever rule principal. **03**

(b) Describe step by step solidification of alloy -1 shown in **Figure-1** up to room temperature with aid of appropriate sketch. **04**

(c) Explain Homogenous nucleation process **07**

Q.8 (a) Draw cooling curves during solidification for pure metal, alloy and hypo-eutectic alloy. **03**

(b) How many degrees of freedom does water have at triple point? Justify your answer with valid reason. **04**

(c) Describe the conditions that govern formation of solid solution. **07**

Figure 1: Phase diagram for element A & B having partial solubility in each other

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–III (NEW) EXAMINATION – WINTER 2021

Subject Code:3131904   **Date:19-02-2022**
Subject Name:Material Science and 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.

Q 1	**(a)**	Differentiate between macro and micro examinations.	**03**
	(b)	Define: (1) Toughness (2) Hardness (3) Hardenability (4) Malleability	**04**
	(c)	Discuss selection criteria for materials used in engineering applications.	**07**
Q 2	**(a)**	Explain a atomic packing factor.	**03**
	(b)	Calculate the APF for BCC and FCC structures.	**04**
	(c)	Discuss mechanisms of quenching of steel. State the advantages and drawbacks of water & oil as quenching media.	**07**
		OR	
	(c)	Explain the different methods for Grain size measurement.	
Q 3	**(a)**	What is phase diagram?	**03**
	(b)	Explain Lever rule.	**04**
	(c)	What is Gibb's phase rule? Define system, phase and degree of freedom. Show that the degree of freedom at eutectic point in a binary phase diagram is zero.	**07**
		OR	
Q 3	**(a)**	What is significance of soaking time provided in annealing or hardening?	**03**
	(b)	What is a eutectic, eutectoid and peritectic reaction.	**04**
	(c)	Draw iron- carbon diagram and mention all major elements.	**07**
Q 4	**(a)**	Write in brief: Hastelloy material.	**03**
	(b)	Give a few applications of copper alloys.	**04**
	(c)	Describe effect of quenching media on properties of steel during heat treatment.	**07**
		OR	
Q 4	**(a)**	What is the main objectives of NDT method?	**03**
	(b)	Explain briefly the two methods of finding carbon percentage in steels.	**04**
	(c)	Explain the effect of Grain size on the properties of metals.	**07**
Q 5	**(a)**	Explain cathodic protection against corrosion.	**03**
	(b)	Explain any one methods for production of metal powders.	**04**
	(c)	What is powder metallurgy? State the applications of powder metallurgy.	**07**
		OR	
Q 5	**(a)**	Draw Jominy hardenability set-up including labeling & important dimensions.	**03**
	(b)	Explain difference between dry type and Wet type corrosion.	**04**
	(c)	Explain the NDT method widely used for inspection of castings.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– III EXAMINATION – SUMMER 2020

Subject Code: 3131904   **Date:28/10/2020**

Subject Name: Material Science and 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.**

			Marks
Q.1	**(a)**	Draw miller indices of [111] and (110).	**03**
	(b)	Define atomic packing factor (APF) and find APF for FCC material.	**04**
	(c)	Do the detailed classification of Engineering Material.	**07**
Q.2	**(a)**	Grain boundary is a defect. Evaluate.	**03**
	(b)	Explain Lever rule with example.	**04**
	(c)	Explain homogeneous and heterogeneous nucleation process with neat sketch.	**07**
		OR	
	(c)	Explain a Nucleation and growth in Solidification of metals.	**07**
Q.3	**(a)**	What is solid solution? Discuss in brief types of solid solution with neat sketch.	**03**
	(b)	Write the difference between impurities and alloying elements. Write importance of alloying.	**04**
	(c)	Explain cooling curve of binary alloy forming solid solution.	**07**
		OR	
Q.3	**(a)**	Explain Point defect & Line defect.	**03**
	(b)	Explain Hume Rothay rule for substitutional solid solution.	**04**
	(c)	Explain the detail procedure of polishing the specimen for micro-examination.	**07**
Q.4	**(a)**	Differentiate between Austenite and Ferrite.	**03**
	(b)	What are the limitations and capabilities of LPT	**04**
	(c)	Draw and label Iron – Iron Carbide diagram. Also explain the reactions taking place in it.	**07**
		OR	
Q.4	**(a)**	Differentiate between LPT and MPT.	**03**
	(b)	Explain the Ultrasonic Testing.	**04**
	(c)	List the common methods of powder production in powder metallurgy & discuss their influences on the properties of final product.	**07**
Q.5	**(a)**	Explain macro examination.	**03**
	(b)	Differentiate between annealing and normalizing.	**04**
	(c)	Draw TTT-diagram for a steel with 0.8% carbon and show austenite to martensite transformations on it.	**07**
		OR	

Q.5 **(a)** Which are surface heat treatment processes? What are the applications of such processes? **03**

(b) Define hardenability of steel. State the factor that affect the hardenability. **04**

(c) Explain the mechanism of corrosion. Also explain any one corrosion prevention technique in detail. **07**

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Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2021

Subject Code:3131904   **Date:08/09/2021**

Subject Name:Material Science and 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)**	Classify various types of engineering materials.	**03**
	(b)	What is a solid solution? Explain with a neat sketch various types of solid solutions.	**04**
	(c)	Draw neatly Iron-Iron carbide equilibrium diagram. Name all important phases, temperatures and reactions.	**07**
Q.2	**(a)**	Define following properties of metals: (a) Hardness, (b) Toughness (c) Fatigue	**03**
	(b)	Explain the importance of microscopic and macroscopic examination of metallic materials.	**04**
	(c)	Define atomic packing factor (APF). Calculate APF for Face centered cubic (FCC) structure with a neat sketch.	**07**
		OR	
	(c)	Explain Edge and screw dislocation with the help of a neat figure.	**07**
Q.3	**(a)**	Briefly explain engineering requirements of materials.	**03**
	(b)	List out the various methods used to combat corrosion.	**04**
	(c)	Define allotropy. Explain it with reference to iron.	**07**
		OR	
Q.3	**(a)**	What are the criteria for the selection of engineering materials?	**03**
	(b)	Classify different types of corrosion.	**04**
	(c)	Explain with a neat sketch Time-Temperature-Transformation (TTT) diagram for a eutectoid composition steel.	**07**
Q.4	**(a)**	List out various applications of powder metallurgy.	**03**
	(b)	Discuss sintering process in powder metallurgy.	**04**
	(c)	Name different types case hardening methods. Explain pack carburizing process with the help of a neat diagram.	**07**
		OR	
Q.4	**(a)**	Explain briefly Full Annealing process.	**03**
	(b)	Explain Austempering process.	**04**
	(c)	Explain with a neat sketch three common methods of powder production and discuss their influence on the properties of the final product.	**07**
Q.5	**(a)**	State and explain Gibb's Phase Rule.	**03**
	(b)	Explain the 'Lever Rule' with the help of a binary phase diagram.	**04**
	(c)	Describe Ultrasonic Testing Method and also mention its advantages and limitations.	**07**
		OR	
Q.5	**(a)**	Explain the process of solidification in metals.	**03**
	(b)	What is non-equilibrium cooling? Explain.	**04**
	(c)	Explain in detail Radiography testing method along with its advantages, disadvantages.	**07**

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Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– III (NEW) EXAMINATION – SUMMER 2022

Subject Code:3131904   **Date:28-07-2022**

Subject Name:Material Science and 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
Q.1	**(a)**	Discuss the significance of material science and metallurgy in the advancement of civilizations.	**03**
	(b)	State the classification of engineering materials.	**04**
	(c)	Discuss the criteria for selection of materials for engineering applications.	**07**
Q.2	**(a)**	State the difference between embryo and nucleus with reference to solidification of metals.	**03**
	(b)	Define atomic packing factor. Calculate the atomic packing factor of FCC structure.	**04**
	(c)	Define the following properties:	**07**

1) Ductility,
2) Creep,
3) Machinability,
4) Plasticity,
5) Yield strength,
6) Hardness and
7) Dielectric strength.

OR

	(c)	Define the following properties:	**07**

1) Malleability,
2) Fatigue,
3) Weldability,
4) Elasticity,
5) Toughness,
6) Brittleness and
7) Superconductivity.

Q.3	**(a)**	Draw the following: (2 0 1), [1 2 3] and (0 0 0 2).	**03**
	(b)	Differentiate between slip and twinning.	**04**
	(c)	Draw a neat sketch of inverted metallurgical microscope and explain in detail the steps involved in specimen preparation for microexamination.	**07**

OR

Q.3	**(a)**	Explain the importance of etchant in microexamination.	**03**
	(b)	Differentiate between edge and screw dislocation.	**04**
	(c)	Define corrosion. Briefly explain the types of corrosion. Explain any one technique for prevention of corrosion.	**07**

Q.4 **(a)** Define degree of freedom. Write the formula to calculate the same for unary and binary system. **03**

(b) Justify: "In spite of the atomic packing factor of BCC is less than FCC lattice, the solubility of carbon is more in austenite than ferrite phase." **04**

(c) Draw TTT diagram for 0.8% eutectoid steel and explain the change of microstructure at varied isothermal transformations and correlate it with properties. **07**

OR

Q.4 **(a)** Define: **03**
    1) Solidus line,
    2) Liquidus line and
    3) Solvus line.

(b) Explain the effect of the following elements in steel: **04**
    1) Chromium and
    2) Manganese.

(c) Draw $Fe - Fe_3C$ phase diagram and write all of the invariant reactions involved in the same. **07**

Q.5 **(a)** Explain the phenomenon of coring (non-equilibrium cooling). **03**
(b) Explain the advantages and disadvantages of powder metallurgy. **04**
(c) List case hardening processes. Explain induction hardening and nitriding in detail. **07**

OR

Q.5 **(a)** List the types of cast iron. **03**
(b) Differentiate between annealing and normalizing. **04**
(c) Define non destructive testing. List various non destructive tests. Explain dye penetrant testing in detail. **07**

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