

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER– III EXAMINATION – SUMMER 2026****Subject Code:3131904****Date:17-06-2026****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) Defend the statement with example: “India has been exceptional in the field of materials science and metallurgy.”	03
	(b) List at least eight different properties in materials that make them useful for engineering applications.	04
	(c) Explain the criteria for selection of materials for engineering applications.	07
Q.2	(a) Define: Unit cell, Crystal structure and Polymorphism.	03
	(b) List major mechanical property requirement for, i) Base of heavy machinery, and ii) Gears in Car	04
	(c) Draw the following: (1 0 0), [1 1 0], (2 1 1), [1 2 2], (0 2 1) and (0 0 0 1)	07
	OR	
	(c) Draw the following: (0 0 1), [0 1 1], (1 2 1), [2 1 2], (1 0 2) and (0 0 0 2)	07
Q.3	(a) Explain the need for use of etchants during microstructure observation.	03
	(b) Differentiate between macroscopic and microscopic examination.	04
	(c) Draw a neatly labeled Fe – Fe ₃ C phase diagram and write all of the invariant reactions taking place in the same.	07
	OR	
Q.3	(a) Define: System, Phase and Component.	03
	(b) What is Degree of Freedom? Write Gibb’s Phase Rule for unary and binary systems.	04
	(c) Explain the mechanism of solidification of metals. Derive the expression to calculate critical radius of nuclei for homogeneous nucleation.	07
Q.4	(a) Differentiate between equilibrium cooling and non-equilibrium cooling.	03
	(b) Write the characteristics of grey cast iron and white cast iron.	04
	(c) Draw TTT diagram for eutectoid steels and explain the significance of cooling rate with example.	07
	OR	
Q.4	(a) State advantages and disadvantages of powder metallurgy.	03
	(b) Draw the microstructure of hypoeutectoid steel and hypereutectoid steels.	04
	(c) Write short notes on Carburizing and Flame hardening.	07

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| Q.5 | (a) List the types of corrosion. | 03 |
| | (b) Explain the principles of eddy current testing along with its advantages and disadvantages. | 04 |
| | (c) State various methods used for metal powder production and explain the atomization method. | 07 |

OR

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| Q.5 | (a) Explain the techniques to prevent corrosion. | 03 |
| | (b) Write a short note on diffusion processes. | 04 |
| | (c) Explain the principles of ultrasonic testing along with its advantages, disadvantages and applications. | 07 |

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III EXAMINATION – SUMMER 2025****Subject Code:3131904****Date:29-05-2025****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.

- Q.1** (a) Define following properties of materials: (a) Strength, (b) Elasticity and (c) Hardness **03**
 (b) Give classification of engineering materials **04**
 (c) Define atomic packing factor (APF). Calculate APF for FCC and BCC structures. **07**
- Q.2** (a) What is a solid solution? Explain with a neat sketch various types of solid solutions. **03**
 (b) Differentiate Macrostructure and Microstructure examination. **04**
 (c) Explain with neat sketch the steps involved in preparing specimen for microscopic examination. **07**
- OR**
- (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**
- Q.3** (a) Explain the process of solidification in metals. **03**
 (b) What is non-equilibrium cooling? Explain. **04**
 (c) Define allotropy. Explain it with reference to iron. **07**
- OR**
- Q.3** (a) State the composition, properties and applications of Hindalium and Invar. **03**
 (b) Explain the 'Lever Rule' with the help of a binary phase diagram. **04**
 (c) Draw Iron-Iron carbide equilibrium diagram. Name all important phases, temperatures and reactions. **07**
- Q.4** (a) Explain full annealing process **03**
 (b) Explain flame hardening process. **04**
 (c) Justify the requirement of Heat treatment processes for metals. Explain with neat sketch TTT diagram for heat treatment of steel. **07**
- OR**
- Q.4** (a) Explain any one method for production of metal powders. **03**
 (b) Explain the steps involved in Dye penetrant testing with neat sketch. **04**
 (c) Define Powder Metallurgy. State advantages, limitations and applications of Powder Metallurgy **07**
- Q.5** (a) Explain cathodic protection against corrosion. **03**
 (b) Compare destructive testing with non-destructive testing. **04**
 (c) Explain in detail Radiography testing method along with its advantages and limitations. **07**
- OR**
- Q.5** (a) Compare nodular cast iron and malleable cast iron. **03**
 (b) Classify different types of corrosion. **04**
 (c) Describe Ultrasonic Testing Method with its advantages and limitations. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III (NEW) EXAMINATION – SUMMER 2024****Subject Code:3131904****Date:19-07-2024****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) Give a brief classification of materials. **03**
 (b) Explain the role of material science and metallurgy in advancement of civilization. **04**
 (c) Explain the criteria for selection of materials for engineering applications. **07**
- Q.2** (a) Explain the concept of allotropy with a relevant example. **03**
 (b) Calculate atomic packing factor for SC and BCC materials. **04**
 (c) Explain the mechanism of crystallization. Derive the formula to calculate critical radius of nuclei for homogeneous nucleation. **07**
- OR**
- (c) Define crystal structure. List and draw seven crystal structures. **07**
- Q.3** (a) List advantages and limitations of spark test. **03**
 (b) Draw edge and screw dislocation. **04**
 (c) Define system, surrounding, phase, component and degree of freedom. Write Gibb's phase rule for unary and binary system. **07**
- OR**
- Q.3** (a) Write a short note on non equilibrium cooling. **03**
 (b) Draw frenkel and schottky defect. **04**
 (c) List and explain the steps in preparation of specimens for microscopic examination. **07**
- Q.4** (a) Draw the microstructure of a solidified pure metal ingot. **03**
 (b) Write invariant reactions of eutectic and peritectoid reaction. **04**
 (c) Draw a well labeled Iron – Iron Carbide phase diagram. **07**
- OR**
- Q.4** (a) Draw a sample cooling curve for pure metal. **03**
 (b) Write invariant reactions of monotectic and eutectoid reaction. **04**
 (c) Define solid solution. List the types of solid solutions. List Hume Rothery rules for solid solution formation. **07**
- Q.5** (a) List methods for production of metal powder. **03**
 (b) Draw a well labeled Time – Temperature – Transformation Diagram. **04**
 (c) List the types of annealing process. Explain full annealing in detail. **07**
- OR**
- Q.5** (a) Write the applications of powder metallurgy. **03**
 (b) List the types of corrosion. Explain any one in brief. **04**
 (c) List non destructive testing methods. Explain dye penetration testing in detail. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III(NEW) EXAMINATION – SUMMER 2023****Subject Code:3131904****Date:26-07-2023****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

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| Q.1 | (a) What is Metallurgy? List the functions of it. | 03 |
| | (b) List Mechanical Properties and explain any 02. | 04 |
| | (c) Explain Bravais Lattice with neat diagrams. | 07 |
| Q.2 | (a) Grain boundary is a crystalline imperfection. Explain | 03 |
| | (b) Determine Miller indices of a plane that makes intercepts of $2A^0$, $3A^0$ and $4A^0$ on coordinate axes of an orthorhombic crystal with $a:b:c = 4:3:2$. | 04 |
| | (c) Explain with neat sketches the arrangement of atoms in B.C.C, F.C.C. and H.C.P. lattice. Show that F.C.C. structure is always more close packed than B.C.C. structure. | 07 |
| OR | | |
| | (c) Explain the different methods for Grain size measurement. | 07 |
| Q.3 | (a) Which information is revealed by micro-examination of metal specimen? | 03 |
| | (b) Name few enchants for steel. What is the function of enchant. | 04 |
| | (c) Describe sample preparation technique for microscopic examination. | 07 |
| OR | | |
| Q.3 | (a) Which information is disclosed by macro-examination? | 03 |
| | (b) What is sulphur printing and how it is executed. | 04 |
| | (c) Explain with neat diagram construction and working of metallurgical microscope. | 07 |
| Q.4 | (a) Explain interstitial solid solution. | 03 |
| | (b) Differentiate between annealing and normalizing | 04 |
| | (c) What are the requirements for the solidification to be initiated and proceed further? | 07 |
| OR | | |
| Q.4 | (a) Explain types of growth of nucleus for metals and alloys. | 03 |
| | (b) What is the difference between homogenous and heterogeneous nucleation process. | 04 |
| | (c) Explain iron-carbon diagram with neat sketch | 07 |
| Q.5 | (a) Explain objective of heat treatment of steel. | 03 |
| | (b) Explain cathodic protection against corrosion. | 04 |
| | (c) Explain in detail Radiography testing method along with its advantages & disadvantages. | 07 |
| OR | | |
| Q.5 | (a) List various heat treatment processes as applied to steels. | 03 |
| | (b) Write the advantages and disadvantages of powder metallurgy. | 04 |
| | (c) Explain different NDT methods used for inspection of castings. | 07 |
