

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
(An Autonomous Institute U/s UGC Act 1956)

B.Tech. SEMESTER-III, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1ME302

DATE: 18-12-2025

SUBJECT NAME: MATERIAL SCIENCE AND METALLURGY

TIME: 11:00 AM to 01:30 PM

TOTAL MARKS: 70

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Cognitive Level (As per Revised Bloom's Taxonomy) (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

| | | Marks | BL | CO |
|------------|---|-----------|----------|----------|
| Q.1 | (a) Differentiate between macro and micro examinations. | 03 | R | 2 |
| | (b) Explain the detail procedure of polishing the specimen for micro examination | 04 | U | 2 |
| Q.2 | (a) Explain the following material properties : Ductility, Fatigue, and Toughness. | 03 | U | 1 |
| | (b) Give selection criteria of material for engineering applications. | 04 | U | 1 |
| | (c) What are engineering materials and how are they classified? | 07 | U | 1 |

OR

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|------------|---|-----------|----------|----------|
| Q.2 | (a) Differentiate between hardness and hardenability. | 03 | U | 1 |
| | (b) Write a Hume-Rothery rules for Substitutional Solid solution formation. | 04 | U | 1 |
| | (c) Explain an atomic packing factor and calculate the APF for BCC and FCC structures. | 07 | U | 1 |
| Q.3 | (a) List the applications of Titanium. | 03 | R | 4 |
| | (b) List the Properties and applications of Nickel alloys. | 04 | R | 4 |
| | (c) State the composition, properties and applications of Hindalium. | 07 | R | 4 |

OR

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|------------|---|-----------|----------|----------|
| Q.3 | (a) List the Properties of Aluminum. | 03 | R | 4 |
| | (b) List the Properties and applications of Tool steel. | 04 | R | 4 |
| | (c) State the composition, properties and applications of Invar. | 07 | R | 4 |

SECTION B

| | | Marks | BL | CO |
|------------|---|--------------|-----------|-----------|
| Q.4 | (a) Describe different stages involving in powder metallurgy in detail. | 03 | U | 6 |
| | (b) Explain Sintering process. | 04 | U | 6 |
| Q.5 | (a) Explain the importance of undercooling in nucleation. | 03 | U | 3 |
| | (b) Using Gibb's phase rule, explain unary phase diagram with the help of sketch. | 04 | U | 3 |
| | (c) Draw Iron – carbon diagram and Explain solid state transformation from austenitic temperature to room temperature for 0.4% carbon steel. | 07 | U | 3 |

OR

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|------------|--|-----------|----------|----------|
| Q.5 | (a) Describe applications of phase diagram. | 03 | U | 3 |
| | (b) Explain homogeneous and heterogeneous nucleation process with neat sketch. | 04 | U | 3 |
| | (c) Draw Iron Carbon Diagram with all notations like Phases and Reactions Nomenclature. | 07 | R | 3 |
| Q.6 | (a) Differentiate between annealing and normalizing. | 03 | R | 5 |
| | (b) What is the purpose of hardening? Explain induction hardening in detail. | 04 | U | 5 |
| | (c) Discuss mechanisms of quenching of steel. State the advantages and drawbacks of water & oil as quenching media. | 07 | U | 5 |

OR

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|------------|--|-----------|----------|----------|
| Q.6 | (a) Define Heat Treatment and classify heat treatment processes. | 03 | R | 5 |
| | (b) Draw Jominy hardenability set-up including labeling & important dimensions. | 04 | R | 5 |
| | (c) Explain with a neat sketch Time-Temperature-Transformation (TTT) diagram for a eutectoid composition steel. | 07 | U | 5 |
