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**Indian Maritime University**  
**(A Central University, Govt of India)**

**Mar/Apr 26 SE**

**Programme Name: B Tech (ME)**

**Semester: III**

**Subject Code: UG11T5304**

**Subject Name: Engineering Materials**

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Date: 24.03.2026

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

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General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.
- (iii) Use of Non-programmable scientific calculator is allowed.

**Section A**

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. The number of atoms per unit cell in a body-centered cubic (BCC) structure is:
    - A. 1
    - B. 2
    - C. 4
    - D. 6
  2. In which of the following Bravais lattices none of the sides and angles are equal?
    - A. Triclinic
    - B. Monoclinic
    - C. Orthorhombic
    - D. All of the mentioned
  3. According to Hume-Rothery rules, extensive solid solubility is favored when the atomic radii difference between two metals is less than:
    - A. 5%
    - B. 10%
    - C. 15%
    - D. 25%
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4. In a binary eutectic system, the reaction that occurs upon cooling is represented as:

- A. Solid  $\rightarrow$  Solid + Gas
- B. Solid<sub>1</sub>  $\rightarrow$  Solid<sub>2</sub> + Liquid
- C. Liquid  $\rightarrow$  Solid
- D. Liquid  $\rightarrow$  Solid<sub>1</sub> + Solid<sub>2</sub>

5. The purpose of tempering hardened steel is to:

- A. Increase hardness
- B. Reduce brittleness
- C. Increase residual stress
- D. All of the above

6. Which of the following processes involves heating the metal in a carbon-rich environment?

- A. Cyaniding
- B. Carburizing
- C. Nitriding
- D. Flame Hardening

7. Nickel is added to steel primarily to:

- A. Increase hardness only
- B. Reduce melting point
- C. Improve toughness
- D. Increase brittleness

8. Chromium improves which of the following properties in steels?

- A. Machinability
- B. Corrosion resistance
- C. Density
- D. Ductility

9. PTFE (Teflon) is primarily used in marine systems for:

- A. Structural members
- B. Electrical insulation and bearings
- C. Fuel tanks
- D. Propeller blades

10. Titanium is used for shipboard heat exchangers mainly because of its:

- A. Low cost
  - B. High electrical conductivity
  - C. Excellent corrosion resistance in seawater
  - D. High density
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### **Section B**

Five Questions of 02 Marks each

11. Among BCC, FCC and HCP which structure metals are more ductile and why?
12. State and explain Hume-Rothery rules for solid solubility?
13. Define Heat Treatment, State need behind Heat Treatment.
14. What are stainless steels? Why they are called stainless?
15. What property of titanium makes it particularly suitable for use in marine environments?

### **Section C**

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. What are crystal structure defects? Classify the defects, and Explain edge dislocation and screw dislocation.
  17. Draw and label the Fe-Fe<sub>3</sub>C phase diagram applicable for steels. State and explain various the transformations occurring in it.
  18. What are TTT diagrams and critical cooling rate? Explain the method of plotting TTT diagram for eutectoid steel.
  19. What is case hardening? State the need and applications of case hardening. Explain any two methods of case hardening.
  20. What are plain carbon steels and alloy steels? State their advantages. Explain the effect of Chromium and Manganese as alloying element.
  21. Classify the materials used in Shipbuilding industry? Which materials are recommended for manufacturing of propellers, pumping and piping systems, marine engine components? Justify your answer.
  22. Discuss the selection of Materials in Shipbuilding and Marine Engineering: steam and gas turbines, Diesel engine components (5+5 marks)
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