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**Question Paper Code : 81649**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Third Semester

Mechanical Engineering

ME 3392 — ENGINEERING MATERIALS AND METALLURGY

(Common to Manufacturing Engineering/Mechanical Engineering  
(Sandwich)/Mechanical Engineering (Specialised in Automobile)/Mechanical  
Engineering (Specialised in Smart Manufacturing))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ( $10 \times 2 = 20$  marks)

1. Define Solid solution.
2. Mention the eutectic reaction in Iron-Carbide diagram.
3. List the types of annealing.
4. Define TTT diagram.
5. Mention the effects of alloying additions on steel.
6. How are copper alloys classified?
7. Differentiate between thermoplastics and thermosets?
8. What is a composite material?
9. Define twinning process.
10. Why are impact specimens notched?

PART B — (5 × 13 = 65 marks)

11. (a) Explain the different types of crystal structures found in metals and their significance in determining material properties.

Or

- (b) Diagnose the micro-constituents of iron-carbon alloys and explain the general characteristics of each.

12. (a) Describe the various stages involved in the heat treatment of steel and their respective purposes.

Or

- (b) Explain the process of martempering and Compare and contrast it with austempering process.

13. (a) Discuss about different types of stainless steel, with reference to approximate compositions, structures, and heat treatments.

Or

- (b) Elaborate the composition, properties, and typical applications of any four copper alloys.

14. (a) Distinguish between matrix and dispersed phases in a composite material and write a note on the polymers: PE, PP and ABS with applications.

Or

- (b) With suitable applications explain the following ceramic materials:

- (i) Alumina
- (ii) Silica
- (iii) Silicon carbide and
- (iv) Silicon nitride.

15. (a) Explain Griffith's theory on brittle fracture and deduce an expression for the critical stress required to propagate a crack simultaneously in a brittle material.

Or

- (b) Explain the standard procedures of

- (i) Tensile test
- (ii) Compression test, and
- (iii) Shear test.

PART C — (1 × 15 = 15 marks)

16. (a) Explain the suitable case hardening process for the following engineering components:
- (i) Massive parts like fasteners
  - (ii) Aircraft engine parts such as cams, cylinder, valve stems etc.
  - (iii) Machine gears and pistons.

Or

- (b) Draw the S-N curve for ferrous and non-ferrous metals and explain the determination of endurance strength of a material. Also discuss the factors that affect fatigue life.
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