A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: R2704

B.E. / B.Tech. DEGREE EXAMINATION, DEC 2025

First Semester

Mechanical Engineering

R21UME204 – ENGINEERING MATERIALS AND METALLURGY

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Alloys containing 2.0-6.7% carbon are considered as _____ CO1- U

   (c) Aluminum (d) Brass (c) Steel (d) Cast-iron

2. According to Hume Rothery's rules, size of atoms must not differ by more than _____ CO1- U

   (a) 5% (b) 15% (c) 35% (d) 55%

3. How is cooling of the material done is normalising process? CO1- U

   (a) Furnace (b) Cooling (c) Still air (d) Liquid chamber

4. Which quenching medium is used for quenching of carbon and low alloy steels? CO1- U

   (a) Vegetable oil (b) Water (c) Air (d) Animal oil

5. In Brinell hardness testing the timer for loading is CO1- U

   (a) 5 sec (b) 15 sec (c) 30 sec (d) 1 minute

6. Which materials are to be tested using an F-scale? CO1- U

   (a) Copper and brass (b) Case hardened steels

   (c) Bronze, gunmetal, and beryllium copper (d) Thermoplastics

7. Tensile strength of an alloy steel can be improved by adding _____ CO1-U

   (a) Nickel (b) Vanadium (c) Manganese (d) Titanium

8. Which of the following material is used for energy storage device (battery)? CO1-U

   (a) steel (b) cast iron (c) Nickel (d) Aluminium

9. Natural polymer is CO1- U

(a) Glucose (b) Teflon (c) PVC (d) Polyamide

10. Which is the most commonly used fluorocarbon polymer? CO1- U

(a) PTFE (b) PVDF (c) PVF (d) PFA

PART – B (5 x 2= 10 Marks)

11. Show the ferrite and cementite in the iron carbide equilibrium diagram. CO1-U

12. Explain the process of heat treatment. CO1-U

13. Compare the Brinell and Vickers hardness test methods. CO1-U

14. Explain the required good properties of a tool steel. CO1-U

15. Distinguish commodity plastics with engineering plastics. CO1-U

PART – C (5 x 16= 80 Marks)

16. (a) Construct the Unary phase diagram of single component system of iron showing gas, liquid, solid phases as a function of temperature and pressure. CO2-App (16)

Or

(b) Build the Peritectic and Peritectoid phase diagram with proper explantion. CO2-App (16)

17. (a) Compare the hardening and tempering of high carbon steels? Give the process details. What are the advantages of hardened and tempered steels?. CO4-App (16)

Or

(b) Compare and contrast the process of full annealing, stress relief annealing, recrystallization annealing and spheroidizing annealing. CO4-App (16)

18. (a) Explain the testing procedure for Rockwell hardness test with neat sketch and mention the advantages and limitations. CO1-U (16)

Or

(b) Explain about the mechanism of plastic deformation and slip and twinning with clear explanation. CO1-U (16)

19. (a) Discuss the composition properties and typical application of any four copper alloys. CO1-U (16)

Or

(b) Discuss the composition, properties, application of aluminium base alloys. CO1-U (16)

20. (a) Explain the different types of plastics? What are the special properties of plastics that make them useful engineering material? Also discuss the fibre reinforced plastics. CO1-U (16)

Or

(b) Discuss the properties and application of the following polymeric materials PMMA, ABS, PPO, PTFE and PVC polymers. CO1-U (16)