Ref. No.: Ex/Met/PC/B/TS/222/2024

B.E. METALLURGICAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2024

Subject: TESTING OF MATERIALS

Time: 3 hours **Full Marks = 100**

(Answer all questions)

Q. No.	Questions	Marks	CO
1	➧ **Answer any one:** **a.** Why Brinell hardness of a material is load-dependent? Provide a detailed explanation of the factors influencing Brinell hardness and how they affect the test results. Discuss the advantages and limitations of this testing method in evaluating material hardness. $(5 + 5 + 4 = 14)$ **b.** Schematically draw an Engineering stress-strain and a True stress-strain curve of a material in a single plot explaining their significance in evaluating material properties. Explain the concept of proof stress. How is it measured, and how does it differ from yield stress? Discuss its significance in material testing and engineering applications. $(4 + 2 + 2 + 2 + 4 = 14)$	14	CO1
2	➧ **Answer any one:** **a.** Explain the Instrumented Charpy test. Discuss how instrumentation enhances the capabilities of the Charpy test in measuring material toughness. Evaluate the advantages and limitations of the Instrumented Charpy test compared to conventional Charpy testing. $(4 + 6 + 4 = 14)$ **b.** Describe the drop weight test. Discuss the testing procedure, equipment used, and parameters measured during the test. Evaluate the importance of the drop weight test in assessing material behavior under dynamic loading conditions. $(4 + 6 + 4 = 14)$	14	CO2
3	➧ **Answer any one:** **a.** Compare and contrast the behavior of materials under tensile loading and compression loading. How do material properties and failure modes differ in these two testing scenarios? Discuss the factors that can lead to failure in materials under compressive loading, such as buckling, and shear failure. $(8 + 6 = 14)$ **b.** Draw typical constant stress creep curves delineating the different stages. Indicate the phenomenological processes in each stage. What factors influence the rate of creep deformation during each stage? $(3 + 6 + 5 = 14)$	14	CO3

4	↓ **Answer any two:** **a.** State the purposes of Micro-indentation at low load over Macro indentation of 0.4 % C air cooled sample. State the advantages of using Knoop indenter over Vickers micro indenter. (3 + 4 = 7) **b.** Describe the principles and applications of ultrasonic testing in non-destructive evaluation. (7) **c.** Compare and contrast liquid penetrant testing and magnetic particle testing as non-destructive testing methods. (7)	7 + 7 = 14	CO4
5	↓ **Answer any one:** **a.** Express the cyclic stress-strain relationship, explaining the terms involved. Describe when cyclic hardening or softening occurs in materials and its significance in fatigue analysis and prediction. (7 + 7 = 14) **b.** Why does fatigue failure typically start from the surface of a specimen under push-pull conditions? Discuss the underlying mechanisms and factors contributing to surface-initiated fatigue failure. How you can delay the fatigue crack initiation? discuss briefly. (10 + 4 = 14)	14	CO5
6	↓ **Answer any five:** **a.** Show, with a neat sketch, why the ratio of the diameter of the indentation to the diameter of the indenter must remain constant to produce geometrically similar indentations in a Brinell test. (6) **b.** Explain how variations in gauge length affect the measurement of tensile elongation and its significance in assessing material performance. (6) **c.** Write a short note on the determination of crack arrest temperature (CAT). (6) **d.** Explain how shot peening alters the material's surface properties to enhance fatigue resistance. (6) **e.** Discuss the conditions under which materials exhibit creep behavior at room temperature and the factors contributing to it. (6) **f.** What are the key factors to consider when selecting a non-destructive testing technique for a specific application or material type? (6)	6 × 5 = 30	CO1 CO2 CO3 CO4 CO5