

Ref. No.: Ex/Met/PC/B/TS/222/2022

**B.E. Metallurgical and Material Engineering 2nd Year 2nd Semester Exam
2022**

Subject: TESTING OF MATERIALS

Time: 3 hours

Full Marks = 100

(Answer question no 8 and any five from the rest)

1.

A. The following hardness data were obtained on copper using a 10 mm diameter hardened steel ball indenter.

Load, (kg)	Dia. of indentation, (mm)
500	3.2
1,000	3.9
1,500	4.6
2,000	5.4
2,500	5.9

i) Determine whether or not Meyer's law is obeyed.

ii) Determine the Meyer's law constants. **(4+4)**

B. What type of indentation could you expect during the Vickers micro-hardness test of cold-rolled material, and why? **(3)**

C. How do you determine flow stress from the hardness test? Give a brief discussion on the temperature dependence hardness of Cu. **(2+3)**

2.

A. Give instruction to a machinist-cum-operator in steps for a tensile test out of a round bar of 16 mm diameter and tabulate the required tensile properties. Consider that the machinist-cum-operator will follow the steps that you mention. **(9)**

B. Explain the concept of the toughness of a material. For example, how can one estimate toughness from the tensile test? **(4+3)**

3. State the purpose of doing an impact test? Define impact transition temperatures? How would you determine the impact transition temperature of a metal? State the metallurgical factors affecting transition temperature. **(2+3+5+6)**

4.

A. What is high cycle fatigue? Explain the mechanism of producing slip band extrusion and intrusion regarding fatigue deformation. **(2+6)**

[Turn over

- B. Express cyclic stress-strain relationship explaining the terms involved. When does cyclic hardening or softening occur? (4+4)

5.

- A. Define Creep. Illustrate an idealized shape of a Creep curve under a constant load test. What will be the nature of the curve under a constant stress state? Explain the different stages of the Creep curve. (1+2+2+4)
- B. What is the stress rupture test? How is it different from the Creep test? State and explain the information obtained from the stress rupture test. (2+2+3)

6.

- A. Define theoretical cohesive strength of a material. Why the material fails below the theoretical cohesive strength – explain. What are the different modes of fracture with suitably drawing the schematics? (2+3+3)
- B. What are the three basic factors contributing to the brittle fracture of steels? Do all three have to be present for brittle fracture to occur? What are the characteristics of fatigue fracture? (3+2+3)

7. **Answer with proper justification:** (4 × 4 = 16)

- A. Brinell hardness of a material is load dependent.
- B. Whether gauge length of tension test specimen has any influence on uniform elongation.
- C. Shot peening is often used to improve the fatigue property of components.
- D. Role of grain size on creep deformation of a material.

8. **Answer any four:** (4 × 5 = 20)

- A. Write a short note on the Resilience of a material.
- B. State the difference between tensile toughness and impact toughness.
- C. Write a short note on the Dye penetrant test.
- D. Write a short note on the Magnetic particle testing method.
- E. Discuss the principle of the Ultrasonic test.