

Ref. No.: Ex/FET/OE/MET/T/220/2023

**B.E. Mechanical Engineering 4<sup>th</sup> Year 2<sup>nd</sup> Semester Exam 2023**

**Subject: Testing and Characterization of Materials**

**Time: 3 hours**

**Full Marks = 100**

*(Answer Question No: 10 and any eight from the rest)*

1. (2+2+2) + 4 = 10

a. What effect will be observed on the hardness value of a material when the indentation is made

- I. At too close to an existing indentation,
- II. At too close to the edge of the specimen and
- III. On inclined plane

Give a brief explanation.

b. Show by means of a sketch that to produce a geometrically similar indentation in a Brinell test ( $d/D$ ) must remain constant.

2. 10

Give instruction to a machinist-cum-operator in steps for doing a tensile test out of a round bar of 12 mm diameter and tabulate the tensile properties that can be measured. Consider that the machinist-cum-operator will follow the steps that you mention.

3. 6 + 4 = 10

a. Draw schematic load vs. displacement, engineering stress vs. engineering strain, and true stress vs. true strain curves on the same diagram for low-carbon steel tested under uniaxial tension. Compare the nature of these curves assigning reasons for differences.

b. What is the strain hardening exponent, and how is it measured? For ideally elastic material, what should be the strain hardening exponent ( $n$ )?

4. 2 + 6 + 2 = 10

What is DBTT? State the standard procedure for estimating the DBTT of a material. What kinds of fracture surface do you expect if a material is tested just below the Nil ductility temperature (NDT)?

[ Turn over

5. **4 + 3 + 3 = 10**
- a. Explain briefly the different stages of fatigue failure of a material. What are the characteristic features observed in the fatigue-fractured surface?
  - b. How the shot pinning can improve the fatigue life of a material.
6. **(4 + 2) + 4 = 10**
- a. Explain briefly the different stages of creep. Which stage is the most important for design purposes among all the stages of creep deformation and why?
  - b. Define creep strength and creep life of a material.
7. **2 + 4 + 4 = 10**
- State two significant aspects of material characterization. What standard techniques can be followed to characterize a material at different magnification levels? What the characteristic features can be detected at a different level of characterization?
8. **(2 + 3) + 5 = 10**
- a. Define corrosion. What is the difference between rusting and corrosion?
  - b. Based on the appearance of corrosion damage, categorize the different forms of corrosion.
9. **4 + 6 = 10**
- a. Distinguish the E.M.F series and Galvanic series in tabular form.
  - b. What are the common testing methods available for measuring the corrosion resistance capacity of materials?
10. **Write a short note on (Answer any five):** **(5 × 4) = 20**
- a. Effect of stress ratio (R) on fatigue strength of a material.
  - b. Stress rupture test.
  - c. X-ray radiography test.
  - d. Magnetic particle testing method
  - e. Intergranular fracture vs. Transgranular fracture
  - f. Standard metallographic techniques for Material characterization.