

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

**B.E. Electrical 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.