

Total Pages—4

(Set-R₁)

B.Tech-6th
Testing of Materials

Full Marks : 70

Time : 3 hours

Answer Q.No.1 and any five questions

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2 × 10
- (a) Calculate the true stress and true strain when the engineering stress and engineering strain values are 1500 MPa and 0.8 respectively.
 - (b) Show the effects of temperature and strain rate on the stress-strain behavior of a material.
 - (c) Write down the load and indenter used for Rockwell C hardness testing.
 - (d) What is Griffith criterion for brittle fracture ? Write down the stress required to propagate a crack in a brittle material.

(Turn Over)

(2)

- (e) Differentiate between ductile and brittle fracture in metals.
 - (f) What information do you get from a Charpy test ?
 - (g) Write the effects of % C on impact toughness of plain carbon steel.
 - (h) What is Vickers hardness testing ? Discuss its importance over other hardness testing methods.
 - (i) What is ductile to brittle transition temperature ? How the crystal structure of a material affects this temperature ?
 - (j) What is Paris law ? How the influence of stress-ratio is incorporated in Paris equation ?
2. Explain the engineering stress-strain curve of a ductile material and define the following properties of the material : 10
- (a) Modulus of elasticity
 - (b) Yield strength

(3)

- (c) Ultimate tensile strength
 - (d) Fracture strength
 - (e) Ductility and
 - (f) Toughness.
3. (a) Derive an expression for theoretical cohesive strength of metals. Explain the discrepancy between the theoretical and actual fracture strength of metals. 7
- (b) Calculate the theoretical cohesive strength of the material if $\gamma_s = 1 \text{ J/m}^2$, $E = 100 \text{ GPa}$ and $a_0 = 5 \times 10^{-10} \text{ m}$. Comment on the calculated value. 3
4. (a) What are different stages of fatigue failure in metals? Explain with suitable illustrations.
- (b) Explain the effect of mean stress on fatigue life. 10
5. (a) Explain the method of K_{IC} plane-strain fracture toughness testing. What are major limitations of this test? 7

(4)

- (b) A sample of an Al-alloy with an edge crack of length $a = 1.5$ mm fractures at a tensile stress of $\sigma_f = 364$ MPa. Find K_{IC} of the alloy. 3
6. (a) Schematically draw the $S-N$ curves for ferrous and non-ferrous metals and explain the curves. 10
- (b) Explain the metallurgical factors affecting the fatigue life of materials. 10
7. (a) Schematically draw creep curves conducted under constant load and constant stress conditions. Explain different stages of creep. 7
- (b) How creep rate varies with temperature and stress? Show with schematic diagram and comment. 3
8. Discuss any three non-destructive testing methods with their advantages and disadvantages for quality inspection and control. 10