Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - 2015-16 Even Semester - May 2016

14ME3040 Engineering Fracture Mechanics

Set A

Time : 3 hrs
Total Marks: 100

1. a. Show the three basic modes of fracture failure with neat sketch and explain the mechanism leading to these failures modes. (12)

   b. Discuss the practical applications of fracture mechanics.(8)

OR

2. a. Derive the field equations of equilibrium from the first principles. Also find the compatibility equations and stress – strain relationships (12)

   b. Describe Griffith analysis of crack failure using the Strain energy release rate.(8)

3. a

   Predict the failure mode and load of the cantilever beam of thickness 5 mm as indicated below: Assume the fracture toughness and yield stress as 30 MPa$\sqrt{m}$ and 300 MPa. What is the failure mode if the yield stress is doubled? Assume nominal stress at the crack as M/Z where M is the bending moment and Z is the section modulus = 400 mm^3. SIF for the edge crack is $K_I = 1.12\ \sigma\sqrt{\pi a}$.

   (10)

   b. A 3 mm thick tension panel 10 cm wide containing an edge crack of 1 mm yielded at a load of 150 kN. However, at a load of 120 kN, another panel of same material cracked into two pieces when the crack was 5 mm long. With this information, calculate the yield stress and fracture toughness of the material. (10)

OR

4. a. An infinitely large sheet is subjected to a gross stress of 350 MPa. There is a central crack 5/π-cm long and the material has a yield strength of 500 MPa. (20)

   (a) Calculate the stress-intensity factor at the tip of the crack.

   (b) Calculate the plastic–zone size at the crack tip.

   (c) Comment upon the validity of this plastic–zone correction factor for the above case.

5. a. Why the shape of the plastic zone is determined approximately. Mention the methods used for its computation.(8)

   b. Describe Irwin approach for the correction of plastic zone size to accommodate stresses in the yield zone.(12)

OR

6. a. Determine the fracture toughness using elastic plastic analysis with the application of J integral.(20)

7. a. Prove the equivalence between Crack tip opening displacement and J integral (20)

OR

8. a. How Paris equation is different from other empirical approaches. (8)

   b.

As a result of welding a component has residual stress field to give a SIF of 90 MPa$\sqrt{m}$. The applied fatigue stress is compressive and varies between 100 and 300 MPa. Calculate the initial cyclic crack growth rate if C= $3.6*10^{-12}$ and N=40000 cycles. (12)

9. a. Differentiate between the approaches of solid mechanics and fracture mechanics (5)

b. Discuss the common non-destructive methods to detect and control fracture. (15)

Wishing you All the Best
