PVP 17

Code: **17MEMD2T5A**

I M.Tech - II Semester – Regular Examinations – AUGUST 2018

FRACTURE MECHANICS
(MACHINE DESIGN)

Duration: 3 hours Max. Marks: 60

Answer the following questions.

1. Define and explain each of the following: 15 M
   a) Stress Intensity factor b) strain energy release rate and
   c) Damage tolerance

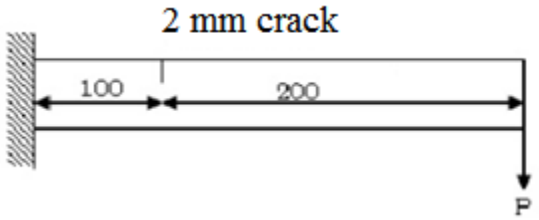
OR

2. a) Discuss the basic modes of fracture with neat diagrams. 7 M

   b) If the specific surface energy for Polmethyl acrylate is 0.037 J /m^2 and its corresponding modulus of elasticity is 2.4 GPa, compute the critical tensile stress required for unstable propagation of a central internal crack whose length is 30 mm. If the strength of the sound glass is 70 MPa, calculate the reduction in strength due to the presence of the crack. 8 M

3. Predict the failure mode and load of the cantilever beam of thickness 5 mm as shown in the figure: 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

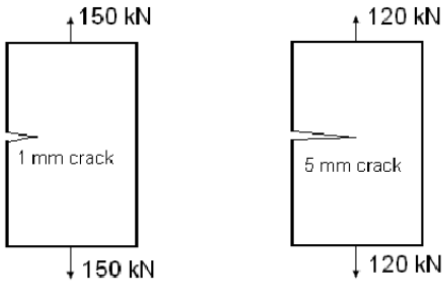
doubled? Assume nominal stress at the crack as M/Z, where, M is the bending moment and Z is the section modulus = 400 mm^3. SIF for the edge crack is $K_I = 1.12\sigma\sqrt{\pi a}$. 15 M



OR

4. A cylindrical pressure vessel, with a diameter of 6.2 m and a wall thickness of 26 mm, underwent a failure when the internal pressure reached 18.6 MPa. The material properties are as under: E = 210 GPa, σ_{ys}= 2450 MPa and G_C = 131 kJ/m^2. i) Using von-Mises criteria assess whether the failure is due to yielding ii) Based on Griffith's analysis assess the failure and also determine the size of crack that might have caused this failure, stating assumptions that you have made. 15 M

5. 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. Take SIF for the edge crack is $K_I = 1.12\sigma\sqrt{\pi a}$. 15 M



OR

6. a) What is the J-Integral and explain its significance? 7 M

b) Establish the relation among CTOD, K_I and G. 8 M

7. a) Write Coffin-Mansion's relations. 7 M

b) Explain different stages of fatigue crack growth. 8 M

OR

8. a) Illustrate the strain-life approach and stress-life approach using S-N curves. 7 M

b) If fatigue test run with a high stress level (sufficient to cause plastic flow) the specimen fails very quickly (less than 10000 cycles). This regime of behaviour is known as Low cycle fatigue (LCF). The fatigue life correlates with the plastic strain amplitude rather than stress amplitude, and it is found that Coffin-Mansion's law gives best fit to emperical data. Explain the statement with your reasons. 8 M