PVP 12

Code: **MEMD1T6A**

I M.Tech - I Semester - Regular Examinations – March 2014

FRACTURE MECHANICS
(MACHINE DESIGN)

Duration: 3 hours Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. Show that the Airy stress function
$$U = Cr^{\frac{3}{2}}(\cos\frac{\theta}{2} + \frac{1}{3}\cos\frac{3\theta}{2})$$
corresponds to a semi-infinite mode I crack with the crack faces at $\theta = \pm\pi$ being unloaded. 14 M

2. a) What are the different dislocation theories considered in fracture of metals? Explain? 7 M

   b) Explain the differences between inter-granular and intra-granular failure of materials? 7 M

3. Verify that the Westergaard function $Z_1 = \frac{Pa}{\pi z(z^2-a^2)^{0.5}}$

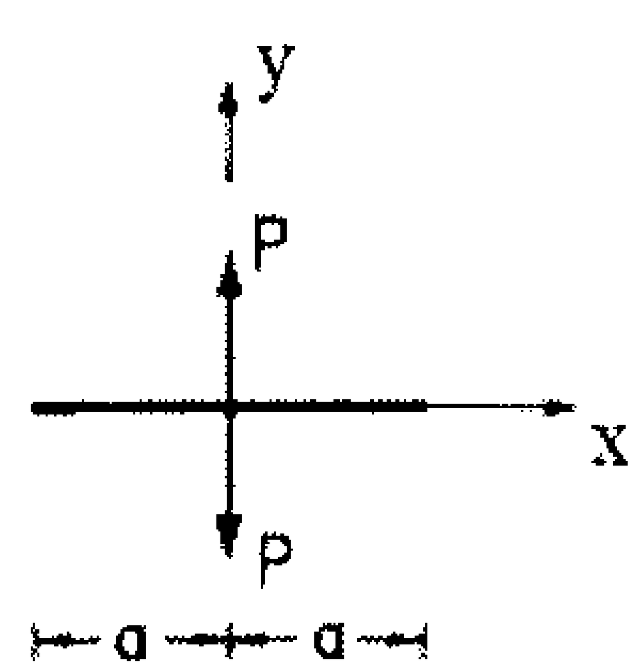

Fig: a

corresponds to the case of a crack of length 2a along the x-axis in an infinite plate opened by a pair of splitting forces P acting at x = 0, y = 0 (Fig: a). Determine the stress intensity factor K_I.

14 M

4. Discuss the experimental determination of critical energy release rate of an interlaminar crack for mode I and II.

   14 M

5. A center cracked large plate of steel with thickness *10* mm is subjected to a uniform tension $\sigma = 300$ MPa perpendicular to the crack plane. Calculate the maximum crack length the plate can withstand without failure. $\sigma_y = 860$ MPa, $K_{IC} = 100$ MPa $\sqrt{m}$.

   14 M

6. A steel structural member with a stress-concentration factor of *3* is subjected to a nominal design stress $\sigma_Y/2$, where σ_y is the yield stress of the material in tension. Using the crack opening displacement design method determine the maximum crack length the member can withstand without failure. The modulus of elasticity of steel is E = *210* GPa, the yield stress is $\sigma_y = 1$ GPa and the critical crack opening displacement is $\delta c = 0.5$ mm.

   14 M

7. Show the relationship between CTOD, K and G? 14 M

8. A plate of thickness 20 mm with a crack of length 50 mm is subjected to displacement controlled loading. The crack starts to grow at a displacement u = 10 mm and continues to propagate under constant displacement until the crack length is 100 mm, when it stops. At the beginning of crack growth the load was measured to be 2 kN and at crack arrest 1.5 kN. Calculate the elastic strain energy released during crack growth. 14 M