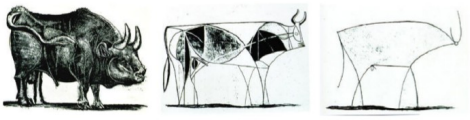

CENTRE FOR MODELING AND SIMULATION
SAVITRIBAI PHULE PUNE UNIVERSITY

GIAN course on

Fracture and Fatigue of Engineering Materials

Nov 17, 2016

105 Marks

Part A: Solve <u>any four</u> of the following numerical problems (15 each, 60 marks):

Q1. Use the K solution for the compact specimen to get K for the following cases:

a) W = 100 mm, B = 25mm a = 55 mm. P = 50 kN
b) W = 100 mm, B = 25 mm a = 55 mm, v = 0.50 mm (load line displacement)

for steel (E = 210 GPa)

Q2. A K_{Ic} test is conducted with P_{max} = 54 kN, P_Q = 50 kN and σ_{ys} = 900 MPa. For a compact specimen with a = B = 25 mm. and W = 50 mm. Determine the results of the test and check validity.

Q3. For a fatigue crack growth rate law given by $da/dN = 1x10^{-11}(\Delta K)^3$
(ΔK, MPa$\sqrt{m}$; da/dN, m/cyc)

a) Find da/dN for ΔK = 30 MPa$\sqrt{m}$
b) Find ΔK for $da/dN = 1x10^{-6}$ m/cyc

Q4. For K_{Ic} = 100 Mpa$\sqrt{m}$, Find the critical crack size for the SE(T) geometry of Prob. 3 and stress of 25 ksi.

Q5. For the crack growth rate law of Prob 3, Find the cycles to failure for an infinite plate with stress range from 0 to 250 MPa, K_{Ic} = 100 MPa$\sqrt{m}$ and a_o = 2 mm.

Part B: Short answer questions (3 each, 45 marks)

1. The three modes of fracture are:

2. Griffith used an _____ approach to fracture

   And Irwin introduced a _____ approach

3. The two main fracture toughness specimens used are:

4. The metal alloy that shows a ductile to brittle transition with temperature change is:

5. Three categories of fatigue are:

6. The fracture mechanics approach differs from a conventional stress based approach how?

7. Region 2 fatigue crack growth can be expressed how analytically?

8. Region 1 fatigue crack growth has what feature that helps in very high cycle applications:

9. What three components are present in environmentally enhanced cracking:

10. For nonlinear fracture mechanics what two fracture parameters are most often used to characterize fracture?

11. What agency writes fracture mechanics test standards in the USA?

12. Two ways to tell that linear elastic fracture mechanics no longer applies are:

13. What three components go into a fracture mechanics analysis?

14. What three parameters are measured in a J_{Ic} test?

15. K increases with crack extension with _____
and decreases with crack extension with _____.