MED25(C) - Fracture Mechanics

P. Pages : 1

Time : Three Hours

7786

GUG/W/23/14201

Max. Marks : 70

_____

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Solve **any five**.

1. a) What are the three modes of loading in fracture mechanics? Explain with neat sketches. **8**

   b) A sample of glass has a crack of half length $2\mu m$. The Young's modulus of the glass is $70\,GN\,m^{-2}$ and the specific surface energy is $1\,Jm^{-2}$. Estimate its fracture strength. **6**

2. a) Describe the importance of R-curve in fracture analysis. **4**

   b) What are Ductile and Brittle fractures? State their characteristics in detail. **3**

   c) Sketch and explain the plastic zone plots for plane stress and plane strain condition. **7**

3. a) The half length of cracks in a steel is $2\mu m$. Taking $Y = 200\,GN\,m^{-2}$, estimate the brittle fracture strength at low temperatures, if true surface energy bis $1.5\,Jm^{-2}$. The actual fracture strength is found to be $1200\,MNm^{-2}$. Estimate the difference, if any, between this and your result. **7**

   b) Write short note on following: **7**
   i) Damage tolerant design. ii) Crack arrest due to dynamic fracture.

4. a) What is fatigue according to ASTM standards? Discuss the various variables that affect the S-N curve? **7**

   b) Define the term 'Energy release rate'. Derive an expression for the energy release rate of cracked plate. **7**

5. a) Explain the effect of plate thickness on fracture toughness. **7**

   b) Write short notes on following. **7**
   i) Environment assisted cracking. ii) Variable amplitude fatigue load.

6. a) Explain the CTOD and determination of it. Discuss the stable and unstable crack growth depending on CTOD. **7**

   b) Discuss the various NDT method of testing used in fracture mechanics. **7**

7. a) Explain the fracture failure in terms of energy. **7**

   b) What is 'J-integral'? Explain the significance of J-integral. **7**

8. a) Explain the mechanism of fatigue crack growth with neat sketch. **7**

   b) Discuss the advantages and disadvantages of Griffith's theory approach? **7**

****