M.Tech. Mechanical Engineering Design (CBCS) Semester - II

MED25(C) - Fracture Mechanics

P. Pages : 1 **GUG/S/23/14201**

Time : Three Hours * 2 9 3 5 * 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** questions.

1. a) Explain 'Variable amplitude fatigue load' in brief. **4**

b) Explain the CTOD and determination of it. Also discuss the stable and unstable crack growth depending on CTOD. **10**

2. 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 b is 1.5 $J\,m^{-2}$. The actual fracture strength is found to be $1200\,MN\,m^{-2}$. Estimate the difference, if any, between this and your result. **4**

b) There are two specimens, one with a surface crack and other one with a edge crack. Crack length (2a) is same for both. Which specimen is critical and why? **3**

c) Explain Griffith theory of fracture. **7**

3. a) What are Ductile and Brittle fractures? State their characteristics in detail. **7**

b) Write short note on: **7**

i) Damage tolerant design ii) Crack arrest due to dynamic fracture.

4. a) Explain the mechanism of fatigue crack initiation and growth with neat sketch. **7**

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

5. a) List and discuss the various NDT method of testing used in fracture mechanics. **7**

b) What are the three modes of loading in fracture mechanics? Explain with neat sketches. **7**

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

b) Describe the importance of R-curve in fracture analysis. **7**

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

b) Write short note on: **7**

i) DBTT ii) Fail-safe design

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

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

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