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

MED25(C) - Fracture Mechanics

P. Pages : 2 **GUG/W/24/14201**

Time : Three Hours * 5 6 9 9 * 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 should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Answer **any five.**

1. a) Plot the S-N curve for ferrous and non-ferrous alloys and enlist the various variables that affect the S-N curve. **4**

b) Enlist various NDT method of testing used in fracture mechanics. Explain any two in detail with neat sketch. **10**

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

b) 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 is 1.5 Jm^{-2}. The actual fracture strength is found to be $200\,MNm^{-2}$. Estimate the difference, if any, between this and your result. **7**

3. a) Explain Griffith theory of fracture with neat sketch. **7**

b) If the specific surface energy for polymethyl acrylate is $0.0365\,J/m^2$ and its corresponding modulus of elasticity is 2.38 GPa, compute the critical tensile stress required for unstable crack propagation of a central internal crack whose length is 30 mm. If the strength of the sound glass is 70MPa, calculate the reduction in strength due to the presence of the crack. **7**

4. a) Explain the CTOD and determination of it. Also discuss the stable and unstable crack growth depending on CTOD. **7**

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

5. a) In a relation to Griffith's theory of fracture, briefly explain why a part is likely to fail when a critical crack length is exceeded? **7**

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

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

b) Write short note on: **7**
i) DBTT ii) Fail-safe design

7. a) Explain the Plane stress and plane strain conditions. What are the recommended specimens for plane strain fracture toughness testing? **7**

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? **7**

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

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

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