Bachelor of Mechanical Engineering

4th year 2nd Semester Examination, 2019

Subject : Fracture Mechanics

Full Marks : 100 time **3 hrs**

Answer any five questions

1. (a) Derive the expression for theoretical cohesive strength of a material.

(b) How does the presence of a crack reduce the fracture stress of a material ?

(c) What is Griffith's crietria and what are its limitations ? 7+7+3+3

2. (a) Deduce the expression for critical strain energy release rate for a fixed load situation.

(b) What are the different modes of crack propagation ? Explain.

(c) How can you correlate stress intensity factor with strain energy release rate in plane stress and plane strain conditions ?

(d) Explain what is meant by fictitious crack length ?

6+6+4+4

3. (a) What are the intrinsic and extrinsic toughening mechanisms ?

(b) What do you mean by transformation toughening ? explain.

(c) What is crack bridging ?

(d) What do you mean by crack-arrest phenomena ?

(e) What are the effects of Ni, Mn on toughness of steel ? 6+4+3+3+4

4. (a) What do you mean MVC ? draw various steps of MVC.

(b) What is Zenner Cottrell model ?

(c) What do you mean by etch pit experiment ? what is its significance ?

(d) What is Dugdale's plastic strip model ? Explain.

(e) Yield point in uniaxial loading is different from that in tri-axial loading. - explain why.

6+4+3+5+2

5 (a) Does thickness of an izod or charpy specimen influence ductile brittle transition temperature of the material ? explain.

(b) What is the effect of strain rate on DBT ?

(c) For few materials we can get fracture toughness values from Izod and Charpy test-explain with example.

(d) What is meant by indentation toughness ?

(e) What is indentation strength method of toughness determination ?

4+4+4+4+4

6.(a) What is persistent slip band ?

(b) How does a fatigue crack propagate ?

(c) What is extrusion-intrusion model ?

(d) Explain how Paris equation can be used for life prediction of an engineering component.

(e) what is meant by striation marks in fatigue crack propagation ?

4+4+4+6+2

7 (a) A material possessing a plane strain fracture toughness of 50 $MPam^{1/2}$ and a yield strength of 1000 MPa is to be made into a large panel.

If the panel is stressed to a level of 250 MPa, what is the maximum size of the flaw that can be tolerated before catastrophic failure occurs ? (assume central notch configuration)

At the point of fracture what is the size of the plastic zone at the middle of the panel along the crack front ?

If the panel were 2.5 cm thick, would this constitute a valid plane strain condition ?

(b) What do you mean by mirror-mist-hackle zone in brittle fracture ? Explain its importance in determining fracture toughness.

(c) What are the mechanisms of fracture in an engineering polymer ?

12+(3+3)+2