

**B.E. MECHANICAL ENGINEERING
FOURTH YEAR FIRST SEMESTER EXAM 2024**

ELEMENTS OF FRACTURE MECHANICS (HONS.)

Time: **3 hours**

Full Marks: **100**

Answer question **no. 1** and **any five** from the remaining questions

1. Answer any ten

10×3=30

- (a) What do you mean by CTOD? What is its importance?
- (b) What is Dugdales plastic strip model?
- (c) What is long crack toughness?
- (d) What is Hall petch equation?
- (e) What is the role of grain size in creep? Explain briefly.
- (f) What is the difference between stress concentration factor and stress intensity factor?
- (g) What is meant by liquid metal embrittlement?
- (h) What is the purpose of etch pit experiment?
- (i) What is meant by stress corrosion cracking?
- (j) What is crack wedging?
- (k) What is crack meandering?
- (l) What is crazing in polymers?

2. (a) Deduce the expression of theoretical cohesive strength.

5+5+2+2

- (b) What is the effect of characteristic flaw on fracture stress?
- (c) What are the limitations of Griffiths criteria?
- (d) What is meant by critical strain energy release rate?

3. (a) What do you mean by R curve?

3+3+3+3+2

- (b) What are the role of alloying elements in controlling toughness of steel?
- (c) Explain the process of transformation toughening with examples.
- (d) What is hydrogen embrittlement?
- (e) What is crack arrest?

4. (a) What do you mean by DBTT?

3+3+3+5

(b) How does specimen thickness affect DBTT?

(b) Why is it not possible to get K_{Ic} from impact test data without sacrificing accuracy except in the case of high carbon steel?

(d) Some aircraft component is fabricated from an alloy with $K_{Ic} = 39 \text{ MPa}\sqrt{\text{m}}$. It has been determined that fracture occurs at a nominal stress of 300MPa if the internal crack length is 3mm. Find out whether fracture will occur for the same component and alloy at a stress of 340MPa if it contains -

- (i) an internal crack of 1.5mm
- (ii) a surface crack of 1.5 mm

5.(a) What is micro void coalescence? Explain with sketch.

5+4+3+2

(b) What is mirror mist hackle zone? What is its importance?

(c) A plate of steel with a central through thickness flaw of length 16 mm is subjected to a stress of 350 MPa normal to the crack plane. If the yield strength of the material is 1350 MPa, what is the plastic zone size at the crack tip?

(d) Explain what is meant by Zener Cottrell model.

[Turn over

- 6.(a) What is Paris equation? 3+4+3+3+1
(b) How can life prediction of a rotating component be done using Paris equation? Explain.
(c) What is persistent slip band?
(d) What is the importance of extrusion- intrusion model in fatigue ?
(e) What is impact fatigue?

7. Write short notes on any four 3.5×4=14
(a) Weibull modulus
(b) Plain strain fracture toughness
(c) Cup and cone form of fracture
(d) Indentation toughness
(e) J1c vs K1c
(f) Geometry parameter, Y