U.S.N.										

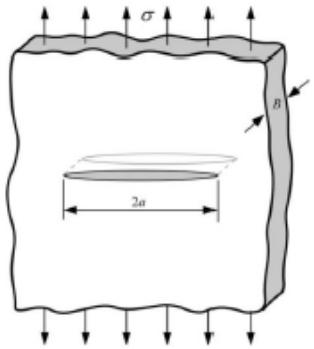
B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

May / June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VIII**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME8PEFRM **Max Marks: 100**
Course: Fracture Mechanics

Instructions: 1. Answer any FIVE full questions, as per the choice indicated.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	CO	PO	Marks
1	a)	Illustrate the importance of fracture mechanics from the design point of view.	CO1	PO1	**05**
	b)	List the important methods used to find cracks in structural components and explain ultrasonic testing.	CO1	PO1	**10**
	c)	What is energy criterion stated by Griffith? Discuss.	CO1	PO1	**05**
		OR			
2	a)	With neat sketches and examples, explain the differences between ductile & brittle fracture.	CO1	PO1	**06**
	b)	What is stress intensity factor? Illustrate the three modes of crack propagation in materials.	CO1	PO1	**10**
	c)	State and discuss the modified Griffith equation.	CO1	PO1	**04**
		UNIT II			
3	a)	Derive plastic zone size according to Dugdale approach.	CO2	PO1	**10**
	b)	Explain the terms (i) Fracture toughness (ii) Critical energy rate. A flat plate with a through-thickness crack is subject to a 100 MPa tensile stress and has a fracture toughness of $50\ MPa\sqrt{m}$. Determine the critical crack length assuming the material is linear-elastic. Also compute the critical energy release rate of the material for E= 207 GPa. 	CO2	PO2	**10**

		OR			
4	a)	Explain the effect of thickness on fracture toughness.	*CO3*	*PO1*	**05**
	b)	What is plane strain fracture toughness? Explain with illustration.	*CO3*	*PO1*	**05**
	b)	A material exhibits the following crack growth resistance behavior. $R=6.95(a-a_o)^{0.5}$ where a_o is the initial crack size. The R parameter has units of kJ/m^2 and the crack size is in millimeters. Consider a wide plate with a through crack such that a<<<w where w is the width of the plate. The elastic modulus of the plate material is 207 GPa. (i) If this plate fractures at 138 MPa, compute the crack size at failure. (ii) If this plate has an initial crack length $2a_0$= 50.8 mm and the plate is loaded till failure, compute the stress at failure.	*CO3*	*PO2*	**10**
		UNIT III			
5	a)	Explain J integral. Discuss the importance of J integral in studying the stress -strain behaviour in the plastic zone.	*CO3*	*PO1*	**10**
	b)	Write a note on (i) CTOD (ii) Paris law.	*CO3*	*PO1*	**10**
		OR			
6	a)	Discuss the experimental determination of CTOD.	*CO3*	*PO1*	**10**
	b)	Explain the basic test procedure and the J_{Ic} measurements.	*CO3*	*PO1*	**10**
		UNIT - IV			
7	a)	Discuss the crack growth rate and its regimes with a suitable sketch.	*CO4*	*PO1*	**10**
	b)	List the factors that affect the fatigue crack propagation and explain any two of them.	*CO4*	*PO1*	**10**
		OR			
8	a)	Discuss the various crack closure mechanisms.	*CO4*	*PO1*	**10**
	b)	Discuss the load spectrum and characteristic occurrences in load-time history.	*CO4*	*PO1*	**10**
		UNIT – V			
9	a)	Explain the principle of crack arrest with the help of a sketch considering ‘G’, ‘R’ and crack length ‘a’	*CO5*	*PO1*	**10**
	b)	Obtain an expression for the crack speed in terms of speed of sound and the crack length.	*CO5*	*PO2*	**10**
		OR			
10	a)	Explain crack arrest in (i) bolted joints (ii) Pipe line with the help of a neat sketch.	*CO5*	*PO1*	**10**
	b)	Explain crack branching with neat sketches.	*CO5*	*PO1*	**10**

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