Reg. No.												

Question Paper Code	11624

M.E. - DEGREE EXAMINATIONS, NOV/DEC 2022

Third Semester

M.E - CAD/CAM

20PCDEL313 - ENGINEERING FRACTURE MECHANICS

(Regulations 2020)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level,CO
1.	List the application of mode- I fracture.	*2,K1,CO1*
2.	Write the Airy's stress function for Mode-II crack problems.	*2,K2,CO1*
3.	Does fracture mechanics recommend the enhancement of the yield stress of an alloy through a heat treatment? Justify your answer.	*2,K2,CO2*
4.	Show the yield planes of plane stress cases through a clear diagram.	*2,K1,CO2*
5.	List any two crack arrest mechanism.	*2,K1,CO3*
6.	Draw R Curves for ductile and brittle materials.	*2,K1,CO3*
7.	What is the threshold stress intensity factor (ΔK_{th}) in Paris equation?	*2,K2,CO6*
8.	Define crack closure.	*2,K1,CO4*
9.	Define Maximum Tangential Stress Criterion.	*2,K1,CO5*
10.	What is mixed mode fracture?	*2,K2,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	Derive Westergaard approach to solve stresses around the crack tip in infinite plate for mode I crack problems.	*13,K3,CO1*
		OR	
	b)	Determine stress components ($\sigma_{\theta\theta}, \sigma_{rr}, \sigma_{r\theta}$) and displacement ($u_r, u_\theta$) in polar coordinates for plane stress.	*13,K2,CO1*
12.	a)	Explain the correction to the elastic crack as per Irwin and dug dale approach.	*13,K2,CO2*
		OR	
	b)	Show the Plastic Zone Shape planes for plane stress and Plane strain cases through a clear diagram.	*13,K2,CO2*
13.	a)	Explain plain strain fracture toughness K_{IC} test methods as per the guide lines given in ASTM standard E399 procedure with more emphasize on precracking.	*13,K2,CO6*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

OR

b) Explain about the R Curve concept in crack growth. *13,K2,CO6*

14. a) An edge crack, detected on a large plate, is of length 3.1 mm under a constant amplitude cyclic load having σ_{max} = 310 MPa and σ_{min} = 172 MPa. If the plate is made of a ferrite pearlite steel and K_{Ic} = 165 MPa $\sqrt{m}$, determine (a) propagation life up to failure and (b) propagation life if the crack length a is not allowed to exceed 25 mm. *13,K2,CO4*

OR

b) Explain the following
(i) Rain flow method. *7,K3,CO4*
(ii) Leak before break analysis. *6,K2,CO4*

15. a) Briefly explain design procedure taking an example of a mechanical component considering with flaws present in the component by fracture mechanics approach. *13,K2,CO5*

OR

b) Explain any three numerical methods to evaluate fracture parameters. *13,K2,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) Write down the equilibrium, compatibility and constitutive equations and hence derive the governing differential equation in terms of stresses/Airy's stress function for the plane elasticity. *15,K3,CO1*

OR

b) Fluctuating load on a critical component of an offshore structure is shown by a histogram in Fig.1. During a routine check-up, an edge crack of length 1.5 mm is detected. If the crack length is not allowed to exceed 25 mm, determine the remaining life of the component. Use Paris law with material constants as C = 6.0 x 10^{-12} $(MPa)^{3.2}$ and m = 3.2. *15,K3,CO4*

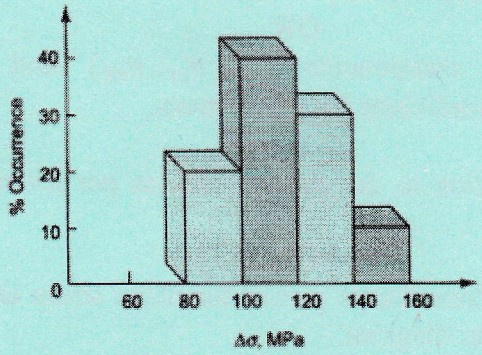

Fig.1