Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Fatigue, Fracture and Stress Analysis of Machine Component **Semester: II**
Program: M. TECH. (ROT EQUIP.) **Time: 03 hrs.**
Course Code: MERE7005 **Max. Marks: 100**

Instructions:

SECTION A

S. No.		Marks	CO
Q.1	Describe stress intensity factors for Mode-I, Mode-II and Mode-III.	**5**	**CO1**
Q.2	Determine the critical crack length in a plate having center crack for Mode – I. The critical stress intensity factor is K_{IC}= 80 MPa$\sqrt{m}$. The average stress applied is 150 MPa.	**5**	**CO4**
Q.3	Derive the expression for energy release rate for a beam of height 2h, thickness B and transverse bending moment M. Modulus of elasticity of the material of the beam is E.	**5**	**CO2**
Q.4	Explain R-curves for ductile materials with appropriate diagrams. What happens to the slope of R-curves with increasing crack length?	**5**	**CO1**

SECTION B

Q.6	Far field stress applied is 140 MPa and length of the edge crack is 25 mm. The factors are given as β^2 = 1.14 and H = 6. Given that E= 205 GPa, n=6.6 and F=1.2×1018 $(MPa)^{6.6}$. Determine the value of J-integral.	**10**	**CO4**
Q.7	An edge crack in large plate is 2.9 mm long. The cyclic load of constant amplitude is σ_{max}=300 MPa and σ_{min}=120 MPa. If K_{IC}=140 MPa$\sqrt{m}$ then calculate, (A) propagation life up-to failure (B) propagation life up-to crack length of 22 mm.	**10**	**CO3**
Q.8	(A)What are the differences between LEFM and EPFM? (B) Explain SN curves for fatigue failure. OR Explain clip gauge method for measurement of COD with appropriate diagrams.	**10**	**CO3**
Q.9	What is the relationship between K_I and G_I for the conditions of plane stress and plane strain? If E=210 GPa, ν=0.3 and K_I=66 MPa$\sqrt{m}$ then find G_I for the conditions of plane stress and plane strain.	**10**	**CO2**

SECTION-C

Q.11	A steel plate has a material of tensile yield strength σ_{yp}=400 MPa. Width is 120 mm and thickness of the plate is 12 mm. There is a center crack of 2a=45 mm. If a stress of 120 MPa is applied then calculate effective crack length. OR A center cracked plate of half width W= 190 mm and thick B= 20 mm is pulled normal to the crack length (half crack length a = 40 mm) with a stress of σ. Calculate the maximum value of σ that can be applied without further crack growth. Given J_p=405 kJ/m^2, n=6, α=5.6, tensile yield strength σ_{yp}=400 MPa and ε_0=0.002.	**20**	**CO4**
Q.12	(A) A uniform plate has a single center crack. The uniform tensile stress applied is 120 MPa. If half crack length a = 25 mm and width of the plate 2W= 150 mm then calculate K_I. Given $f(\propto)=1.12-0.23\propto+10.55\propto^2-21.72\propto^3+30.39\propto^4$. (B) A plate has double edge cracks. A uniform tensile stress of 150 MPa is applied. Half crack length is a=25 mm and width of the plate is 2W= 100 mm. Determine K_I. Given $f(\propto)=1.12-0.20\propto-1.20\propto^2+1.93\propto^3$.	**20**	**CO3**