Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER I (NEW) EXAMINATION – WINTER - 2018

Subject Code: 3710801 **Date: 03/01/2019**

Subject Name: Advanced Machine Design

Time: 02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Draw and explain the rheological models for plastic deformation and their responses to different strain inputs.	**07**
	(b)	Describe the modified Coulomb-Mohr theory.	**07**
Q.2	**(a)**	The stresses at a point in a body are: f_x = 91 MN/m^2, f_y = 21 MN/m^2, f_{xy} (shear stress) = 84 MN/m^2, yield point stress = 280 MN/m^2. Find the factor of safety: 1. By the maximum shear stress theory. 2. By the distortion energy theory.	**07**
	(b)	(i) Explain design procedure for finite life. (ii) Explain design procedure for infinite life.	**07**
		OR	
	(b)	(i) Discuss the Strain Vs Life Curve for variable load. (ii) Explain fatigue crack propagation and life estimation for variable amplitude stress.	**07**
Q.3	**(a)**	(i) Explain Manson's method. (ii) Define: (i) Notch sensitivity (ii) Stress concentration	**07**
	(b)	Estimate the life of a shaft ϕ35 mm made of alloy steel for which f_{ut} = 550 MPa. The bending stress at the most critical section has been determined to be 180MPa. Assume C_F = 0.85, K_f = 1.585.	**07**
		OR	
Q.3	**(a)**	Explain following term in detail: (i) Crack propagation criteria. (ii) Stress intensity factor.	**07**
	(b)	A cold drawn steel bar is to withstand a tensile preload of 36.3 kN and a fluctuating tensile load varying from 0 to 72.60 kN. The bar has a geometric stress concentration factor of 2.02 corresponding to a fillet whose radius is 4.75 mm. Determine the size of the bar for an infinite life and a factor of safety of 2. The material properties are f_{yp} = 588.0 N/mm^2, f_{ut} = 700 N/mm^2. Assume surface finish factor = 0.73, load factor = 0.85, average value of material constant = 0.25 and endurance limit = 0.5 x ultimate stress.	**07**
Q.4	**(a)**	Explain the following: (i) Effect of crack strength of ductile material. (ii) Different between Hydrostatic and Hydrodynamic lubrication system.	**07**
	(b)	Calculate the time to rupture at 650°C and 100MPa stress for a 1%Cr-1% Mo-0.25%V steel, according to the Larson-Miller and Sherby-Dorn, if this alloy underwent rupture in 20hrs when tested in tension at the same stress level at a temperature of 750°C. Assume Q = 460 kJ/mol.	**07**
		OR	
Q.4	**(a)**	Explain the following: (i) Factor affecting the fracture of material. (ii) Define: (i) Failure due to fatigue (ii) Failure due to creep.	**07**

(b) What are the failure criteria for structural component for justified life? Explain any one with case study. **07**

Q.5 **(a)** Discuss about different mode of lubrication for mechanical rotating part and gives practical example of them. **07**

(b) A cylindrical pressure vessel is constructed from a long, narrow steel plate by wrapping the plate around a mandrel and then welding along the edges of the plate to make an helical joint (see figure-1 below). The helical weld makes an angle $\alpha = 55°$ with the longitudinal axis. The vessel has an inner radius r =1.8m and a wall thickness t = 20mm. The material is steel with a modulus E=200GPa and a Poisson's ratio ν=0.30. The internal pressure is 800kPa.

Calculate the following quantities for the cylindrical part of the vessel:

The circumferential and longitudinal stresses σ_1 and σ_2 respectively. The maximum in-plane and out-of-plane shear stresses. The circumferential and longitudinal strains ε_1 and ε_2 respectively and The normal stress σ_w and shear stress τw acting perpendicular and parallel, respectively, to the welded seam.

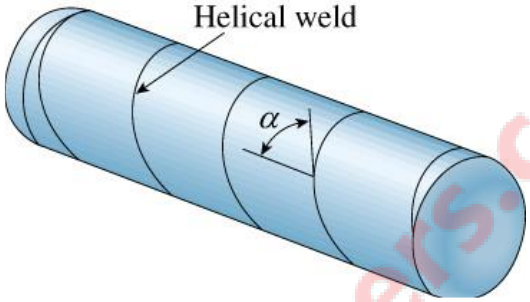

Figure-1

OR

Q.5 **(a)** Explain the following: **07**

(i) Different mode of energy dissipation in material.

(ii) Define: (i) True stress (ii) True strain.

(b) What is surface fatigue? Derive expression for size of contact patch and static stress distribution in cylindrical contact. **07**

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