Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER –I-(New) EXAMINATION – SUMMER 2019

Subject Code: 3710801 **Date: 10/05/2019**

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)**	Explain various modes of fracture with neat sketches.	**07**
	(b)	What is stress concentration? Explain methods for reducing stress concentration with suitable sketches.	**07**
Q.2	**(a)**	Explain Tresca theory and Von-Mises theory.	**07**
	(b)	What is creep? Explain the creep curve.	**07**
		OR	
	(b)	Explain the types of creep and factor affecting the creep.	**07**
Q.3	**(a)**	Explain contact pressure distribution when two sphere bodies are in elastic contact under the applied force and also, derive contact pressure equation for the same.	**07**
	(b)	Explain the term wear. Explain in detail different types of wear experienced in mechanical systems.	**07**
		OR	
Q.3	**(a)**	Explain the hydrostatic and elasto hydrodynamic lubrication in detail.	**06**
	(b)	Explain the following in respect to surface characteristics: (i) Waviness; (ii) Surface roughness; (iii) Sampling length; (iv) Contact area; (v) Bearing area curve; (vi) Real area of contact; (vii) CLA (viii) RMS	**08**
Q.4	**(a)**	Draw and explain the modified Soderberg diagram for Spring design.	**06**
	(b)	The work cycle of mechanical component is subjected to a complete reversed bending stresses consisting of the following three elements: 1) ± 300N/mm^2 for 30% of time. 2) ± 275N/mm^2 for 25% of time. 3) ± 400N/mm^2 for 10% of time. 4) ± 325N/mm^2 for 25% of time. 5) No load for remaining time. The component has ultimate strength 1200MPa. Consider, Surface finish factor as 0.8, size factor as 0.85, temperature factor 0.5 and reliability factor as 0.897.Assume the fatigue stress factor at the most stressed section as 0.7. Determine the life of the component.	**08**
		OR	
Q.4	**(a)**	Explain the fatigue design under combined stresses.	**06**
	(b)	(1) Prove that in case of cyclic loading amplitude ratio is given by; $A = \frac{1-R}{1+R}$, where R is the stress ratio. (2) Develop the equation for Goodman's criterion of failure.	**08**
Q.5	**(a)**	What do you understand by compatibility equations? Discuss the physical significance of compatibility.	**08**

(b) Based on Griffith's analysis derive that stress required to advance a crack of length *2a* for plane stress cases is; **06**

$$\sigma_C \geq \left[\frac{2E\gamma}{\pi a}\right]^{1/2}$$

Where, γ is surface energy per unit area of one surface and E is Young's modulus.

OR

Q.5 **(a)** Components of the stress tensor σ at a point, with respect to the (x, y, z) coordinate system, are given as **08**

$$[\sigma] = \begin{bmatrix} 18 & 24 & 0 \\ 24 & 32 & 0 \\ 0 & 0 & -20 \end{bmatrix} \text{(MPa)}.$$

Find the principal invariants of $\boldsymbol{\sigma}$. *Also find* the octahedral normal and octahedral shear stresses.

(b) A large and thick plate containing a though-the-thickness central crack is 4-mm long and it fractures when a tensile stress of 7MPa is applied. Calculate the strain-energy release rate using a) the Griffith theory and b) the LEFM approach. Assume E =62000MPa, ν = 0.2. Assume Crack geometric correction factor one. **06**

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