Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2710801 **Date: 09-01-2015**

Subject Name: Advanced Machine Design

Time: 02:30 pm - 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)**	For the plane state of stress conditions derive the equations of two principal stresses and maximum shear stress.	**07**
	(b)	Define the following terms with reference to fatigue failure; Corrected Endurance strength, Stress amplitude, Notch sensitivity, Repeated loads, Reversed loads, Stress concentration factor, Fatigue life	**07**
Q.2	**(a)**	Define Wear? Explain different mechanism of wear?	**07**
	(b)	Give overview of general criteria for materials selection and material selection process.	**07**
		OR	
	(b)	(i) Write a Hooke's law and extend this concept to derive generalized Hooke's law for relating six strain components with stress components assuming linear variation of stress with strain for homogeneous material.	**04**
		(ii) Sketch the flow curves for Rigid Perfectly Plastic, Elastic Perfectly Plastic and Elastic Linear Strain Hardening materials.	**03**
Q.3	**(a)**	Explain the concept of design for X (DFX) along with steps for implementing a DFX strategy.	**07**
	(b)	Based on the Griffith's analysis, discuss the variation of energy release E_R and required energy E_S with crack length with the help of neat sketch.	**07**
		OR	
Q.3	**(a)**	(i) Explain the concept of plane state of strain.	**04**
		(i) Strain gauge measurements made on the free surfaces of a steel plate indicate the principal strains are 0.005 and 0.002. What are the principal stresses? (E = 200 GPa and $\nu = 0.3$)	**03**
	(b)	Define crack resistance and discuss the variation of crack resistance with increase in crack length for ductile materials and brittle materials.	**07**
Q.4	**(a)**	(i) Explain the Miner's Rule for cumulative damage in fatigue.	**03**
		(ii) Explain the fatigue design under combined stress.	**04**
	(b)	At a section of steel shaft where diameter changes from 430mm to 300mm, the fillet radius provided is 7.5mm. The shaft is finished by fine turning. The section is subjected to a constant bending moment of 470kNm. Assume: Yield strength of material is 350MPa, Notch sensitivity is 0.8, Surface finish factor is 0.8, Size factor is 0.75, Ultimate tensile strength is 500MPa, Fatigue stress concentration factor is 2.28, and Endurance strength of specimen is 210MPa. Determine the life expected in revolutions of the shaft.	**07**
		OR	
Q.4	**(a)**	Explain the Strain based approach to determine the fatigue life.	**07**
	(b)	What is creep? Enlist Factor affecting creep and explain various stage of creep with diagram.	**07**

Q.5	(a)	Discuss the different modes of lubrication with neat sketches.	07
	(b)	(i) In reference to theories of failure discuss Von Mises' criterion.	04
		(ii). For the state of stress given below whether yielding will occur or not? If not, also calculate factor of safety. $\sigma_x = 200$ MPa, $\sigma_y = 100$ MPa, $\sigma_z = -50$ MPa, $\tau_{xy} = 30$ MPa For material under consideration $\sigma_{yield} = 500$ MPa.	03

OR

Q.5	(a)	Two mating spur gears are 20 mm wide, one made from steel and second made from cast iron gear and the tooth profiles have radii of curvature at the line of contact of 10 and 15 mm. A force of 250 N is transmitted between them.($V_1 = 0.30$, $E_1 = 207$ GPa and $V_2 = 0.26$, $E_2 = 103$GPa) (i) Compute the maximum contact pressure and the width of contact. (ii) How deep below the surface is the maximum shear stress, and what is its value?	07
	(b)	(i) Differentiate creep and stress relaxation.	04
		(ii). Define three modes of fracture with the help of neat sketch.	03

****