Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – WINTER • 2014

Subject Code: 140605 Date: 02-01-2015

Subject Name: Advanced Strength of Materials

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)**	Define strain energy and derive the expression for strain energy due to torsion.	**07**
	(b)	State and explain: i) Maxwell's reciprocal theorem ii) Castigliano's first theorem	**07**
Q.2	**(a)**	List the theories of elastic failure and explain maximum principal strain theory.	**07**
	(b)	A steel bolt is subjected to a direct pull of 30 KN and transverse shear force of 20 KN. Calculate the diameter of bolt using i) maximum principal stress theory ii) maximum shear stress theory iii) total strain energy theory.	**07**
		OR	
	(b)	A rectangular section of steel having depth to width ratio 1.2 is subjected to axial pull of 20 KN and shear force of 4 KN with a factor of safety 2.5. Design the cross section based on total strain energy theory. The yield stress of steel is 300 MPa.	**07**
Q.3	**(a)**	Derive the Lame's equation for the stresses in thick cylinder subjected to internal pressure. Also state the assumption made for the derivation.	**07**
	(b)	A thin steel disc of uniform thickness and 300 mm diameter with a central hole of 60 mm diameter rotates at 10000 rpm. Calculate the maximum principal stress and maximum shear stress in the disc.	**07**
		OR	
Q.3	**(a)**	Derive the expression for the stresses in rotating disc of uniform thickness.	**07**
	(b)	A thick cylindrical shell closed at ends has internal radius 150 mm and external radius 200 mm. it is subjected to en internal pressure of 50 MPa and external pressure of 20 MPa. Determine the hoop stresses and radial stresses on inner and outer surface of the cylinder. Also calculate the longitudinal stress and maximum shear stress.	**07**
Q.4	**(a)**	Derive the formula for deflection of an open coil helical spring subjected to axial load.	**07**
	(b)	A curved beam of rectangular section 20 mm x 40 mm is subjected to pure bending with couple of 400 N.m. The mean radius of curvature is 50 mm. find the maximum and minimum stresses. Also find the position of the neutral axis. Sketch the bending stress variation across the section.	**07**
		OR	
Q.4	**(a)**	State the assumptions made and derive the expression for the curved beam with small initial curvature.	**07**
	(b)	Calculate the length of a flat spiral spring of strip 35 mm wide and 0.5 mm thick to store 5 joules of energy for a limiting stress of 250 MPa. Also calculate the stress and no. of turns required for winding the spring. E = 210 GPa.	**07**
Q.5	**(a)**	A thin channel section has outside flange and web dimensions of 100mm and 200 mm respectively. The thickness of flanges and web is uniform and 5 mm. Draw the shear stress and shear flow distribution for the section and find the position of the shear center. Consider value of shear force = 60 KN.	**07**

(b) A laminated steel spring simply supported at ends with a span of 700 mm centrally loaded with a load of 7000N. the central deflection under the above load is not to exceed 50 mm and maximum bending stress is to be 350 N/mm^2. Determine: i) width of plates ii) thickness of the leaves iii) no. of leaves iv) length of the leaves. V) overlap of the leaves vi) radius to which the leaves should be bend so that the spring become straight under the given load. Assume that the width is 12 times the thickness. E= 200 GPa. **07**

OR

Q.5 **(a)** Derive the expression for the shear stress distribution for triangular section. Also sketch the distribution diagram. **07**

(b) A central horizontal section of a hook is a symmetrical trapezium 80 mm deep. The inner width of 60 mm and outer width of 30 mm. Calculate the extreme stresses when the hook carries a load of 30 KN. The load line is passing 40 mm from the inside edge of the section and centre of curvature being in the load line. Also plot the stress distribution across the section. **07**

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