Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – IV • EXAMINATION – WINTER 2012

Subject code: 140605 **Date: 31/12/2012**

Subject Name: Advanced Strength of Materials

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

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

Q.1	**(a)**	Derive expressions for finding out strain energy stored in a member due to (i) Impact load (ii) Shear	**04**
	(b)	State Castigliano's first theorem and Maxwell's reciprocal theorem.	**03**
	(c)	A uniform metal bar of rectangular section 50mm × 25mm is of length 1.5m. Find the Strain energy stored in the bar when a load of 150 kN is gradually applied to it. If the elastic limit of the metal with which the bar is made is 160 N/mm^2, also find proof resilience and modulus of resilience.	**07**
Q.2	**(a)**	Stating assumptions derive Lame's equations to find out the stresses in a thick cylindrical shell.	**07**
	(b)	A member having square cross section is subjected to axial pull of 15 kN and shear force of 10 kN. Design the cross section of member based on (i) The maximum principal stress theory (ii) The maximum shear stress theory. For a member elastic limit in axial tension is 250 MPa, Poisson's Ratio = 0.3 and Factor of safety = 2.5.	**07**
		OR	
	(b)	A compound cylinder is made by shrinking a cylinder of external diameter 200 mm and internal diameter 175mm over another cylinder of external diameter 175mm and internal diameter 125mm. The radial pressure at junction after shrinking is 8 MPa. Find the final stress set up across the section, when compound cylinder is subjected to an internal fluid pressure of 80 MPa.	**07**
Q.3	**(a)**	Explain given failure theories (i) Maximum Principal strain theory (ii) Maximum strain energy theory.	**07**
	(b)	A hollow cylinder has an external diameter of 300 mm and thickness of the wall is 50mm. The cylinder is subjected to an internal fluid pressure = 40MPa and external pressure = 3.5 MPa. Calculate the maximum and minimum circumferential stresses and plot the variation of the same across the wall thickness.	**07**
		OR	
Q.3	**(a)**	Find an expression for the bending moment in a circular ring which is subjected to a tensile load along the diameter.	**07**
	(b)	A curved beam, rectangular in cross-section is subjected to pure bending of 400 Nm. The beam has width of 20mm, depth of 40mm and curved in a plane parallel to the depth. The mean radius of curvature is 50mm. Find the position of neutral axis, maximum bending compressive stress and maximum bending tensile stress. Also plot the variation of the bending stress across the section.	**07**
Q.4	**(a)**	Derive the equation of shear stress, bending stress, deflection and angular rotation for open helical spring.	**07**
	(b)	A flat spiral spring is 6mm wide and 0.25mm thick, the leangth is 2.5m. Assuming the maximum stress of 700 MPa to occur at the point of greatest bending moment, determine (i) The torque (ii) The work stored in the spring	**07**

(iii) The number of turns to wind up spring. Take E=200 GPa.

OR

Q.4 **(a)** A central horizontal section of a hook is a symmetrical trapezium 90mm deep. The inner width being 100mm and outer being 50mm. the hook carries a load of 70 kN, the load line passes at a distance of 40mm from the inside edge of the section. The centre of curvature is in the load line. Calculate the extreme intensities of stresses. Also plot the stress distribution across the section. **07**

Q.4 **(b)** A laminated steel spring simply supported at ends with span of 0.75m is centrally loaded with a load of 8 kN. The central deflection under the above load is not to exceed 50mm and the maximum stress is to be 415 MPa, determine; (i) width of plate (ii) thickness of plate (iii) number of plates (iv) the radius to which plates should be bent so that the spring become straight under the given 7.5 kN load. Assume width= 12 x thickness and E= 200 GPa. **07**

Q.5 **(a)** Plot shear stress distribution diagram for any three standard sections. **03**

(b) A simply supported timber beam of rectangular cross-section 120mm wide and 200mm deep. The span of beam is 5m and permissible shear stress is 5MPa. Compute the allowable UDL on beam. **04**

(c) A flat steel disc of uniform thickness and 1m diameter rotates at 3600 r.p.m. Determine the intensities of principal stresses. Take density of material is 7.85×10^{-5} N/mm^3 and Poisson's Ratio = 1/3. **07**

OR

Q.5 **(a)** Derive expression of hoop stress in rotating ring (rim). **03**

(b) A flywheel rim of 6m mean diameter is rotated so that maximum hoop stress in the material is 8 MPa. If density of the material of fly wheel is 7000 kg/m^3, find the allowable speed neglecting arm effect. **04**

(c) A thin channel section has outside flange and web dimensions of 100mm and 200mm respectively. The thickness of flanges and web is uniform and equal to 4mm. Draw the shear stress and shear flow distribution for the section and find the position of the shear center. Take value of shear force at section = 60 kN. **07**

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