Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – WINTER 2015

Subject Code: 140605 **Date:06/01/2016**

Subject Name: Advanced Strength of Materials

Time: 02:30pm to 05:00pm **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)**	Derive the equation of Total Strain Energy stored in a body of volume "**V**" subjected to three principal stresses.	**07**
	(b)	State and explain Maxwell's reciprocal theorem and Castigliano's first and second theorems.	**07**
Q.2	**(a)**	Explain given failures theories: (i) Maximum Principal Stress theory (ii) Shear Strain Energy theory	**07**
	(b)	A steel bolt is subjected to a direct pull of 40 kN and transverse shear force of 20 kN. Calculate the diameter of the bolt using (i) Maximum Shear Stress theory and (ii) Total Strain Energy theory. Consider yield stress = 250 MPa, factor of safety = 2 and poisson's ratio = 0.3 for steel.	**07**
		OR	
	(b)	Find the diameter of a shaft, if it is subjected to maximum bending moment of 12 kNm and a maximum torque of 15 kNm at a particular section. The elastic limit stress in simple tension is 210 N/mm^2. Use maximum shear stress theory.	**07**
Q.3	**(a)**	Derive the equation to calculate strain energy for semi-elliptical leaf spring with "**n**" leaves subjected to central point load.	**07**
	(b)	An open coiled helical spring is subjected to combined axial load and torque. The spring is made of 10 mm diameter wire, mean coil diameter 100 mm and 12 coils. The angle of helix is 25°. Find the value of axial load and torque which would extend the spring by 6 mm with no rotation of coils, indicating if the torque tends to wind or unwind the spring. Take G = 90 GPa and E = 210 GPa.	**07**
		OR	
Q.3	**(a)**	Derive the equation to calculate strain energy for flat spiral spring subjected to winding moment "**M**" to the spindle.	**07**
	(b)	A quarter elliptic spring 800 mm long having 10 leaves of 10 mm thickness each, is to absorb energy of 150 Joules when the load due to energy acts at the free end. Find the width of leaves if the bending stress is limited to 300 N/mm^2. What is the initial radius of curvature if the spring becomes straight finally? Find also maximum deflection and the load corresponding to above energy at the free end. Consider E = 200 GPa.	**07**
Q.4	**(a)**	Derive Lame's equations for a thick cylindrical shell subjected to internal fluid pressure "**p**".	**07**
	(b)	A closed ring of mean radius 150 mm is subjected to a pull of 25 kN, the line of action of which passes through its centre. The ring is circular in cross-section with a radius 50 mm. Find the maximum tensile and compressive stresses in the ring and draw stress distribution diagrams at intrados and extrados.	**07**
		OR	

Q.4	**(a)**	A curved beam of circular cross section of 50 mm diameter is subjected to pure bending moment of 600 Nm. The mean radius of curvature is 60 mm. calculate maximum tensile and compressive stresses. Also find the position of neutral axis and draw stress distribution diagram.	**07**
	(b)	A thick cylindrical shell closed at ends having internal diameter 240 mm and thickness 60 mm is subjected to an internal and external pressures of 80 MPa and 40 MPa respectively. Determine hoop stresses on inside and outside surface of the cylinder. Also calculate longitudinal stress and maximum shear stress.	**07**
Q.5	**(a)**	Prove that maximum shear stress is 1.33 times average shear stress for solid circular section.	**07**
	(b)	While rotating at a certain speed, the maximum radial pressure in a circular disc of uniform thickness is 30 MPa. The external radius of the disc is 450 mm and internal radius is 150 mm. Determine the speed of the disc. Also determine maximum hoop stress. The density of the disc material is 7500 kg/m^3 and poisson's ration is 0.3.	**07**

OR

Q.5	**(a)**	What is a disc of uniform strength? Derive an expression for the thickness variation of such a disc along its diameter.	**07**
	(b)	A beam of channel section with overall dimensions 100 mm x 50 mm has uniform thickness of 10 mm. Locate the shear centre. Draw distribution of shear stress in flanges and web when a shear force of 120 kN acts through the shear centre of the section.	**07**

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