Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- IVth SEMESTER–EXAMINATION – MAY/JUNE- 2012

Subject code: 140605 **Date: 31/05/2012**

Subject Name: Advanced Strength of Materials

Time: 10:30 am – 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Whenever necessary, take Modulus of elasticity (E), Modulus of rigidity (C), Poisson's ratio (ν) and density (ρ) for steel as 200 GPa, 80 GPa, 0.3 and 7.85 Mg/m^3 respectively**

Q.1	(a)	(i) Derive the formula for stress due to impact loading	**04**
		(ii) State and explain Maxwell's reciprocal theorem.	**03**
	(b)	Using Castigliano's theorem, calculate the propped reaction for the beam as shown in figure-1. Take EI as constant.	**07**
Q.2	(a)	Explain maximum principal stress theory and maximum principal strain theory for failure.	**07**
	(b)	A rectangular section of steel having depth to width ratio 1.2 is subjected to axial pull of 12 kN and shear force of 3.6 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**
		OR	
	(b)	Find the diameter of the steel shaft based on shear strain energy theory if it is subjected to maximum twisting moment of 20 kNm and maximum bending moment of 12 kNm. The design stress for tension is 150 MPa.	**07**
Q.3	(a)	Derive the Lame's equation for the stresses in thick cylinder subjected to internal pressure. Also state the assumptions made.	**07**
	(b)	A cylinder with external 300 mm ϕ and metal thickness 80 mm is internal pressure of 60 MPa and external pressure of 10 MPa. Calculate circumferential stress at inner and outer surface. Also calculate radial and circumferential stress at mid thickness and plot the variation of the same across the thickness.	**07**
		OR	
Q.3	(a)	Derive the expression for stresses in rotationg disc.	**07**
	(b)	A steel flywheel rim of mean 4 m ϕ is uniformly rotating so that the maximum hoop stress in the material is 8 MPa. Find the angular speed in RPM. Neglect the arm effect.	**07**
Q.4	(a)	(i) Define and explain shear centre.	**03**
		(ii) Draw the shear stress variation for rectangular, circular, triangular, symmetrical I, symmetrical H, symmetrical C, symmetrical T and square resting at 45° at corner.	**04**
	(b)	Locate the shear centre with sketch for the section as shown in figure-2.	**07**
		OR	

Q. 4 (a) (i) Derive the expression: $\tau = \frac{Va\bar{y}}{bI}$ for shear stress variation with usually notations. **04**

(ii) A cantilever steel beam 120 mm wide x 200 mm deep is subjected to UDL on entire span. If the maximum shear stress is 100 MPa find the span. **03**

(b) A quarterly laminated steel cantilever spring of span 400 mm is loaded at the free end by 4 kN point load. The deflection under the load shall not exceed 20 mm and the maximum stress is 300 MPa, find the required dimensions of the spring if thickness to breadth ratio for leaf is 1/5. The spring becomes straight due to the load. **07**

Q.5 (a) (i) Derive the formula for bending of the beam having small initial curvature. **04**

(ii) Compare the bending of straight beam and curved beam. **03**

(b) The trapezoidal section of a curved steel beam is shown in figure-3. The section is subjected to bending moment of 300 Nm. Find and plot the bending stress distribution. **07**

OR

Q.5 (a) Derive the formula for deflection of an open coil helical spring subjected to axial load. **07**

(b) For the steel rod as shown in figure-4, find the stress in each portion. **07**

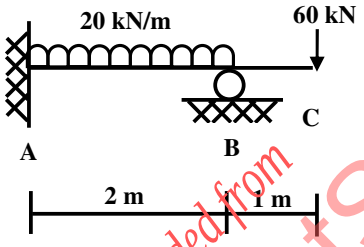

Figure-1 Q-1 (b)

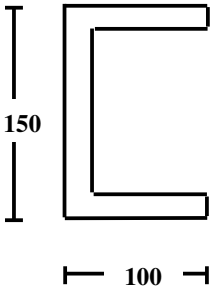

Figure-2 Q-4 (b)

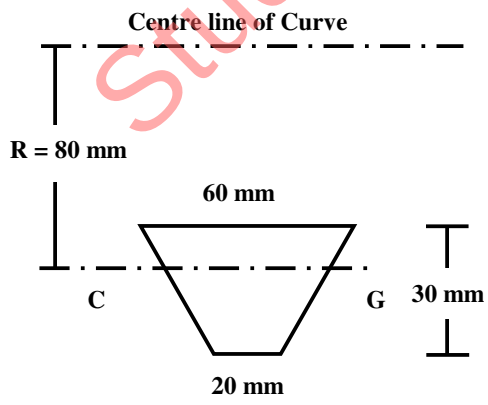

Figure-3 Q-5 (b)

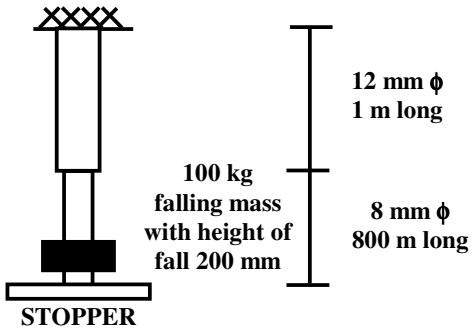

Figure-4 Q-5 (b) OR