Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem - IV Examination June- 2011

Subject code: 140605

Subject Name: Advanced Strength of Materials

Date:13/06/2011 **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.**

Q.1 **(a)** Define: Proof resilience, Shear center, Modulus of resilience, Strain energy. **04**

(b) State and prove Maxwell's theorem of reciprocal deflections. **03**

(c) A wire having 2 mm diameter is 300mm long. It hangs freely from a ceiling The wire has a collar at the bottom end. A weight of 10N is dropped on the collar through a height of 100mm. Find the maximum value of dynamic stress in the wire. E=210GPa. **07**

Q.2 **(a)** An open-coiled helical spring made from wire of circular cross section is required to carry a load of 100 N. The wire diameter is 8 mm & the mean coil radius is 40 mm. If the helix angle of the spring is 30° and no. of turns is 12, calculate: (i) Axial deflection, (ii) Angular rotation of the free end with respect to fixed end of the spring, (iii) intensity of shear stress and (iv) bending stress. Take G = 80GPa. **07**

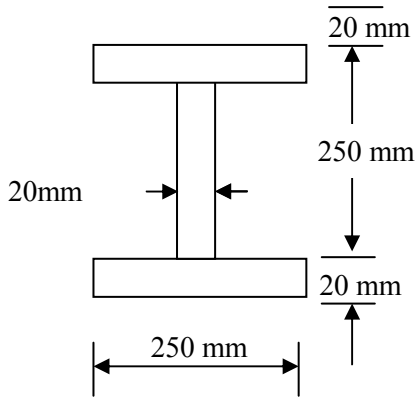
(b) A flat steel disc of uniform thickness and of 1 m diameter rotates at 2400 r.p.m if the disc has a central hole 200 mm diameter. Determine the intensities of principal stresses. Take density=7.85 * 10^{-5} N/mm^2 and m=3. **07**

OR

(b) A flat steel disc 76 cm outside diameter with 16 mm diameter hole is shrunk fitted on to a solid steel shaft. If the shrinkage allowance is 0.008 cm on radius, Calculate: (i) The speed at which the shrink fit will loosen. (ii) The maximum hoop stress in the disc at the speed calculated in part (i). Take ρ=7600 kg/m^3, E=206GPa and μ=0.3 **07**

Q.3 **(a)** Derive Winkler Bach formula for bending of curved beams of large curvature. **04**

(b) Locate the position of shear centre for thin I-section as shown in figure below. **03**

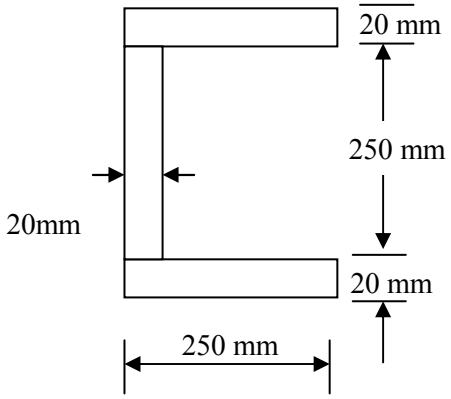


(c) A central horizontal section of hook is a symmetrical trapezium 50 mm deep, the inner width being 60 mm and the outer width being 30 mm. Estimate the extreme intensities of stress when the hook carries a load of 27 kN, the load line passing 40 mm from the inside edge of the section and the centre of curvature being in the load line. Also, plot the stress distribution across the section. **07**

OR

Q.3 **(a)** Derive the formula of simple bending with small initial curvature. **04**

(b) Locate the position of shear centre for thin channel section as shown in figure below. **03**



(c) A crane hook curved to an internal diameter of 200 mm carries a load of 50 kN. The cross section of the hook is a T-section with a flange 100mm wide by 20mm thick and a web is 80 mm deep by 20mm thick. The flange is on the concave side. Determine the maximum stress in the cross section. **07**

Q.4 **(a)** Explain maximum principal stress theory. **03**

(b) A closely coiled helical spring is made of 8mm diameter wire find the mean radius and no. of turns if the permissible shear stress is 80 N/mm^2 and deflection should not exceed 10mm under 250N load. Take G =$8.6*10^4$ N/mm^2. **04**

(c) A circular shaft of 80 mm diameter is subjected to combined bending and twisting moments, the bending moment being four times the twisting moment. Find the allowable twisting moment according to (i) maximum principal stress theory, (ii) maximum shear stress theory, and (iii) distortion energy theory. Given, the stress at the elastic limit is 4 N/mm^2 and the factor of safety is 3. **07**

OR

Q.4 **(a)** Explain maximum principal strain theory. **03**

(b) A closed coiled helical spring of 10 mm in diameter having 12 complete turns with an average diameter of 150 mm is subjected to an axial load of 200 N. Determine : (1) deflection of the spring, (2) stiffness of the spring and (3) maximum shear stress in the material. Take G=80 GPa. **04**

(c) A bolt is subjected to an axial pull of 12 kN together with a transverse shear force of 6 kN. Determine the diameter of the bolt according to (i) maximum principal stress theory, (ii) maximum shear stress theory, and (iii) maximum strain theory, (iv) strain energy theory, and (v) shear strain energy theory. Given, the stress at the elastic limit is 300 N/mm^2, the factor of safety is 3 and Poisson's ratio 0.3. **07**

Q.5 **(a)** A simply supported beam of span 5 m carries a uniformly distributed load 4 kN/m over entire span. The Beam of T-section has the following dimensions: Flanges- 150mm * 20 mm, Web - 300 mm * 20 mm. Calculate shear stresses at different sections and draw stress distribution diagram. **07**

(b) A thick cylinder of inside diameter 200mm and outside diameter 300mm is subjected to internal and external pressures of 50 MPa and 15 MPa respectively. Find the hoop stress at the internal and external surfaces of the cylinder and the hoop and radial stresses at mean radius. Also sketch the variation of radial and hoop stresses across the thickness of the cylinder. **07**

OR

Q.5 **(a)** A simply supported beam of span 5 m carries a uniformly distributed load 4 kN/m over entire span. The Beam of I-section has the following dimensions: Flanges- 150mm * 20 mm, Web - 300 mm * 20 mm. Calculate shear stresses at different sections and draw stress distribution diagram. **07**

(b) The internal fluid pressure in a cylindrical shell is 6 MPa. The external and internal diameters of the shell are respectively 400mm and 200 mm. find the maximum and minimum hoop stress in the cylinder material. Also sketch the radial stress distribution and circumferential stress distribution across the section. **07**

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