L 1043

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2006.

Fourth Semester

Civil Engineering

CE 1252 — STRENGTH OF MATERIALS

(Regulation 2004)

(Common to B.E. (Part-Time) Third Semester)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the expression for the strain energy due to bending moment of a simply supported beam carrying a load 'W' spread over its entire length uniformly.

2. State Maxwell's reciprocal theorem.

3. A simply supported beam of span l carries a uniformly distributed load of W per metre length. The beam was propped at the middle of the span. Find the amount, by which the prop should yield, inorder to make all the three reactions equal.

4. State the theorem of three moments.

5. Explain how the Euler's formula for a mild steel column is not valid, when the slenderness ratio is less than 80.

6. State any four assumptions made in Lame's theory.

7. Write down the formula for the shear stress on the octahedron plane.

8. State Von Mise's theory of failure.

9. Define 'Fatigue'.

10. Define unsymmetrical bending.

11. (i)   Derive a relation for strain energy due to torsion.   (6)

     (ii) A hollow shaft having the external diameter, twice the internal diameter, subjected to a pure torque, attains a maximum shear stress τ. Show that the strain energy stored per unit volume of the shaft is $5\tau^2/16G$. Such a shaft is required to transmit 4500 kW at 110 r.p.m. with uniform torque, the maximum stress not exceeding 70 MN/m². Calculate the shaft diameter and the energy stored per m³ when transmitting this power $G = 83$ GN/m².   (10)

12. (a)   Draw shear force and bending moment diagram for a simply supported beam with a uniformly distributed load over entire span and propped at the centre. Also derive relations for slope at the ends and maximum deflection.

Or

     (b)   A fixed beam of ACB of span 6 m is carrying a uniformly distributed load of 4 kN/m over the left half of the span AC. Find the fixing moments and support reactions.

13. (a)   A 'T' section 150 mm × 120 mm × 20 mm is used as a strut of 4 m long with hinged at its both ends. Calculate the crippling load, if Young's modulus for the material is 200 GPa.

Or

     (b)   A steel cylinder is 1 m inside diameter and is to be designed for an internal pressure of 8 MN/m². Calculate the thickness if the maximum shearing stress is not to exceed 35 MN/m². Calculate the increase in volume, due to working pressure, if the cylinder is 6 m long with closed ends. Neglect any constraints due to ends. E = 200 GN/m². Poisson's ratio = 1/3.

14. (a)   In a triaxial stress system, the six components of the stress at a point are given below :

$\sigma_x = 6\,\text{MN/m}^2$, $\sigma_y = 5\,\text{MN/m}^2$, $\sigma_z = 4\,\text{MN/m}^2$, $\tau_{xy} = \tau_{yx} = 1\,\text{MN/m}^2$,

$\tau_{yz} = \tau_{zy} = 3\,\text{MN/m}^2$, $\tau_{zx} = \tau_{xz} = 2\,\text{MN/m}^2$.

Find the magnitudes of three principal stresses.

Or

     (b)   In a two dimensional stress system, the direct stresses on two mutually perpendicular planes are σ and 120 MN/m². In addition these planes carry a shear stress of 40 MN/m². Find the value of σ at which the shear strain energy is least. If failure occurs at this value of the shear strain energy, estimate the elastic limit of the material in simple tension. Take the factor of safety on elastic limit as 3.

15. (a) Find the centroidal principal moments of inertia of a equal angle section 30 mm × 30 mm × 10 mm.

Or

(b) An equal angle section 150 mm × 150 mm × 10 mm is used as a simply supported beam of 4 m length is subjected to a vertical load passing through the centroid. Determine bending stress at point A as shown in Fig. Q. 15 (b).

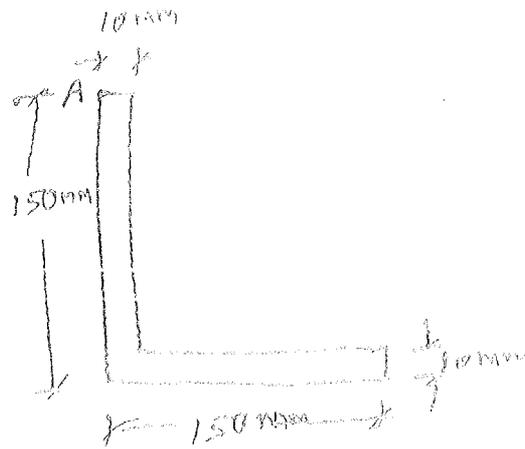Fig. Q. 15 (b)