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Q 2108

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Third Semester

Civil Engineering

CE 231 — MECHANICS OF SOLIDS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define factor of safety.

2. Define modulus of rigidity.

3. What is the significance of point of zero shear? How is it located?

4. Draw the SFD for a simply supported beam of span 'L' subjected to a clockwise moment at one end.

5. When a truss is said to be internally determinate?

6. Why the loads are generally applied at the joints in the case of a truss?

7. Draw the qualitative shear stress distribution of a triangular section.

8. Define polar moment of inertia.

9. Explain the usefulness of Mohr's circle of stress.

10. Define conjugate beam. Give any two examples.

PART B — ($5 \times 16 = 80$ marks)

11. (a) If a tension test bar is found to taper from (D + a) cm diameter (D – a) cm diameter, prove that error involved in using the mean diameter, to calculate Young's modulus is $(10a/D)^2$ percent.

Or

(b) A mild steel plate, 20 mm thick and 30 cm wide at one end, tapers uniformly to 15 mm thickness and 20 cm width at the other end. Find the elongation under an axial pull of 20 kN, if the length is 2 m.

12. (a) Determine the forces produced in each bar of the tower shown in Fig. 1 due to horizontal force P applied at the top as shown.

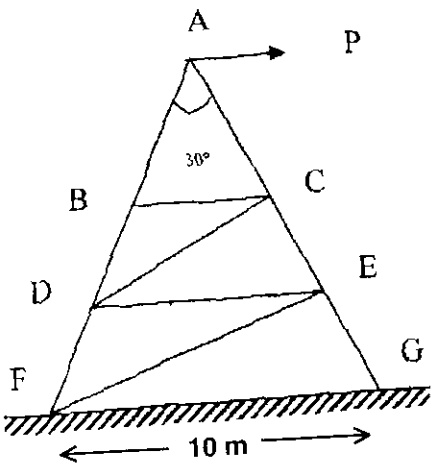

Fig. 12 (a)

Or

(b) A timber beam, having a rectangular cross-section, is loaded with a uniform load of w kg/m. If allowable design stresses are 10 N/mm^2 in bending and 1 N/mm^2 in shear, what is the span to depth ratio such that the allowable flexural and shear stresses will occur simultaneously?

13. (a) A beam of length 10 m is simply supported at its ends and carries a load which varies uniformly form zero at left end to 40 kN per meter at right end. Draw SF and BM diagrams.

Or

(b) A beam is supported on two supports B and C which are 24 m apart; it is cantilevered on the left by 4 m to A and on the right by 8 m to D, so that the total length from A to D is 36 m. It carries a UDL of 20 kN per metre throughout and, in addition, a concentrated load of 60 kN at A and another of 80 kN, 6 m to the right of B. Find the point in the span BC where the positive moment is the maximum and calculate its amount. Draw a B.M. diagram with the given loading.

14. (a) (i) A circular shaft of length L is subjected to a torque T. Show that the total strain energy in the twisted shaft is given by the expression :

$$U = \frac{T^2 L}{2GJ}$$

Where G = Modulus of rigidity

J = Polar moment of inertia of the section.

(ii) Using the above expression for strain energy of torsion or otherwise, prove that the deflection δ of a close – coiled helical spring is given by

$$\delta = \frac{64nPR^3}{Gd^4}$$

Where P = axial load on the spring

R = radius of the cylindrical surface containing the centre of the spring

D = diameter of the cross-section of the wire of the coil

N = number of coils.

Or

(b) A round bar of diameter 4 cm is subjected to an axial tensile load of 200 kN. At a normal section, a shear force of 50 kN acts vertically. On an element of the section, find

(i) the principal stresses and their directions

(ii) the critical shear stresses and their planes

(iii) the normal stresses on the planes of critical shear stresses

(iv) the stress which acting alone, will produce the same maximum strain.

Take Poisson's ratio = 0.3.

15. (a) A horizontal beam AB, having moment of inertia I, is simply supported over a span L. The beam carries two concentrated loads P symmetrically placed at distance L/3 from the supports A and B. Find expressions for (i) end slopes at A and B (ii) central deflection and (iii) slope and deflection under a load P.

Or

(b) A uniform beam is supported at its ends and carries a UDL along the middle half. Show that the additional deflection due to the load is 57/64 times the deflection had the load been concentrated at the mid-point.
