E 285

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2003.

Third Semester

Chemical Engineering

(Common to Textile Technology and Leather Technology)

CH 235 — MECHANICS OF SOLIDS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. When is a material said to be perfectly elastic?

2. What is Poisson's ratio?

3. What do you mean by the bending moment at a cross section of a beam?

4. Draw the shear force and bending moment diagram for a simply supported beam subjected to a concentrated load at the mid span.

5. Write the expression for maximum deflection at the mid span and slope at the support of a simply supported beam subjected to a udl of w/m run over the entire span l.

6. What is meant by conjugate beam?

7. What is meant by modulus of a section?

8. A cast iron cantilever beam of length l 1.5 m fails when a load of 2000 N is applied at the free end. Determine the stress at failure if the section of the cantilever beam is 40 mm × 60 mm.

9. Define the stiffness of a spring.

10. What is the effective length of a column?

PART B — ($5 \times 16 = 80$ marks)

11. A simply supported beam AB of span 9 m carries a uniformly distributed load of 2000 N/m over the part CD of the beam so that AC = 2 m, CD = 4 m and DB = 3 m. Draw the shear force and bending moment diagram.

12. (a) A reinforced concrete column is 300 mm × 300 mm in section. The column is provided with 8 bars of 16 mm diameter. The column carries a load of 400 kN. Find the stresses in concrete and steel bars. Take $E_s = 2.1 \times 10^5$ N/mm^2 and $E_c = 0.14 \times 10^5$ N/mm^2.

Or

(b) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and are 500 mm apart. Diameter and length of each rod are 20 mm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 6000 N such that the cross bar remains horizontal even after loading. Find the tension in each rod and the position of the load on the bar. $E_s = 2 \times 10^5$ N/mm^2 ; $E_c = 1 \times 10^5$ N/mm^2

13. (a) A beam of span l simply supported at its ends carries two concentrated loads W at a distance $l/4$ from each support. Find the deflection at the load point and the maximum deflection.

Or

(b) A beam of uniform section is simply supported over a span of 5 m and carries a point load of 50 kN at 1 m from right support. Find the central deflection. Also find the position and magnitude of maximum deflection I = 7.83×10^7 mm^4 and E = 2×10^5 N/mm^2. Adopt conjugate beam method.

14. (a) A hollow shaft is to have an outside diameter d and inside diameter $d/2$. Calculate the minimum value of d if it is to transmit 375 kW at 105 rpm with a working stress of 35 N/mm^2. Determine the twist in a length equal to 10 times the external diameter. Take C = 8×10^N N/mm^2.

Or

(b) A bar of length 4 m when used as a simply supported beam and subjected to a udl of 30 kN/m over the whole span deflects 18 mm at the centre. Determine the crippling loads when it is used as a column with the following end conditions.

(i) both ends hinged

(ii) one end fixed and the other end hinged.

15. (a) A beam is of square section of side b. If the permissible bending stress if f, find the moment of resistance when the beam section is placed such that

(i) the two sides are horizontal

(ii) one diagonal is vertical.

Find also the ratio of the flexural strengths of the section in the two positions.

Or

(b) A laminated wooden beam 100 mm wide and 150 mm deep is made of three planks of 100 mm × 50 mm glued together to resist the longitudinal shear. The beam is simply supported over a span of 3 m. If the allowable shear stress in the glued joint is 0.35 N/mm^2, find the safe concentrated load that the beam can carry at its mid span.
