Reg. No.

Question Paper Code : **57155**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fourth Semester

Civil Engineering

CE 6402 – STRENGTH OF MATERIALS

(Common to Fourth Semester Petrochemical Engineering and Third Semester Plastic Technology and Polymer Technology)

(Regulations 2013)

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Write down the expression for strain energy

    (a) due to torsion for a hollow shaft.

    (b) due to shear.

2. State Maxwell's reciprocal theorem.

3. What are fixed beams ? What are the advantages of a fixed beam over a simply supported beam ?

4. How will you apply Clapeyron's theorem of three moments to a continuous beam with fixed end supports ?

5. Explain how the failure of a short and of a long column takes place.

6. What are the different methods of reducing hoop stresses in thick cylindrical shells ?

7. What do you understand by stress tensor ?

8. State Maximum principal stress theory. What are its limitations ?

9. Why unsymmetrical bending occurs ?

10. Write down the general expression for stresses in curved beams.

11. (a) Compare the strain energies of the following two shafts subjected to the same maximum shear stress in torsion.

     (i) A hollow shaft having outer diameter 'n' times the inner diameter.

     (ii) A solid shaft. **(16)**

<div align="center">OR</div>

(b) Using Castigliano's theorem, obtain the deflection under a single concentrated load applied to a simply supported beam shown in Fig. 1. $EI = 2.2$ MNm^2. **(16)**
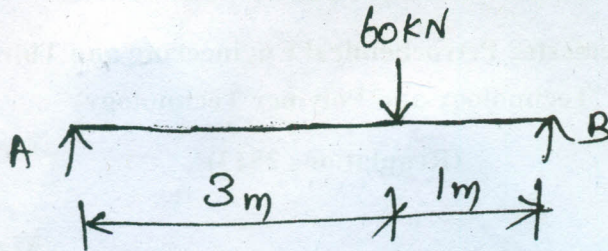

Figure-1

12 (a) A fixed beam AB of length 6 m carries point load of 160 kN and 120 kN at a distance of 2 m and 4 m from the left end A. Find the fixed end moments and reactions at the supports. Draw bending moment and shear force diagrams. **(16)**

<div align="center">OR</div>

(b) A continuous beam ABCD, simply supported at A, B, C and D is loaded as shown in Fig. 2. EI is constant for the entire length of the beam. Find the support moments and draw bending moment and shear force diagrams. **(16)**
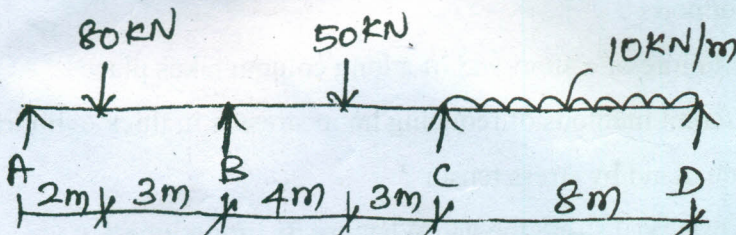

Figure-2

13. (a) (i) Derive the expression for crippling load when one end of the column is fixed and the other end is free. **(10)**

(ii) A hollow mild steel tube 6 m long 40 mm internal diameter and 5 mm thick is used as a strut with both ends hinged. Find the crippling load and safe load taking factor of safety as 3. Take $E = 2 \times 10^5 \, N/mm^2$. **(6)**

OR

(b) Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of 8 N/mm^2. Also sketch the radial pressure distribution and hoop stress distribution across the section. **(16)**

14. (a) The state of stress at a point is given by the matrix,

$$[\sigma_{ij}] = \begin{bmatrix} 110 & 60 & 0 \\ 60 & -86 & 0 \\ 0 & 0 & 55 \end{bmatrix} \text{MPa}$$

Determine the principal stresses, the direction cosines of the principal stress and the maximum shear stress. **(16)**

OR

(b) Define and explain the following theories of failure :

(i) Maximum principal stress theory **(4)**

(ii) Maximum principal strain theory **(4)**

(iii) Maximum strain energy theory **(4)**

(iv) Energy distortion theory **(4)**

15. (a) A beam of T-section (flange :100 mm × 20 mm; web: 150 mm × 10 mm) is 2.5 metres in length and is simply supported at the ends. It carries a load of 3.2 kN inclined at 20° to the vertical and passing through the centroid of the section. If E = 200 GN/m², calculate

     (i) Maximum tensile stress   (5)

     (ii) Maximum compressive stress   (5)

     (iii) Deflection due to the load   (4)

     (iv) Position of the neutral axis   (2)

OR

(b) A steel ring has a rectangular cross-section, 75 mm in the radial direction and 45 mm perpendicular to the radial direction. If the mean radius of the ring is 150 mm and maximum tensile stress is limited to 180 MN/m², calculate the tensile load the ring carry.   (16)

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