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.

PART – B (5 × 16 = 80 Marks)

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)**

OR

(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)**

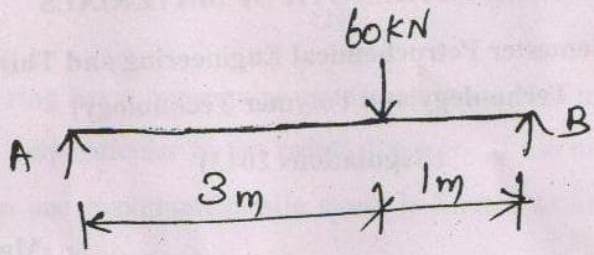

Figure-1

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)**

OR

(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)**

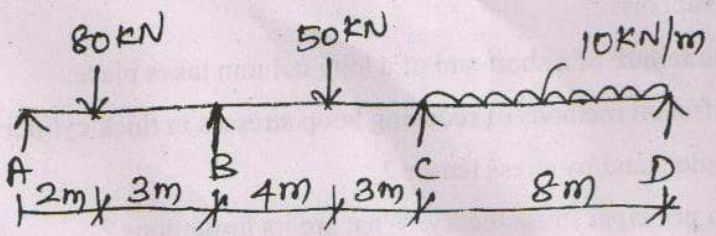

Figure-2

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/m^2, 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/m^2, calculate the tensile load the ring carry. **(16)**
