*X20293*　　Reg. No. : 

**Question Paper Code : X20293**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
AND APRIL/MAY 2021
Third/Fourth Semester
Civil Engineering
CE 6402 – STRENGTH OF MATERIALS
(Common to Petrochemical Engineering/Plastic Technology/Polymer Technology)
(Regulations 2013)
(Also Common to PTCE 6402 – Strength of Materials for B.E. (Part-Time)
– Second Semester – Civil Engineering – Regulations 2014)

Time : Three Hours　　Maximum : 100 Marks

Answer ALL questions.

PART – A　　**(10×2=20 Marks)**

1. Define virtual work.
2. Discuss the Williot diagram.
3. What is statically indeterminate beam ?
4. What are the methods used to solve indeterminate beams.
5. Describe the critical load.
6. Write short notes on thin and thick cylinders.
7. Describe the failure theory.
8. What is principal stress and strain ?
9. Distinguish between neutral axis and centroidal axis.
10. What do you mean by shear centre ?

PART – B **(5×13 =65 Marks)**

11. a) i) A circular bar of 25 mm diameter and 4 m long is subjected to a tensile load of 75 kN is gradually applied. lf the value of Young's modulus $E = 2 \times 10^5$ N/mm$^2$, calculate the increase in length, stress in the bar and the strain energy stored in the bar during extension. **(6)**

ii) Using Castigliano's theorem, obtain the deflection under a single concentrated load applied to a simply supported beam shown in Fig Q. 11 .a.ii. Let El = 2.2 MNm$^2$. **(7)**

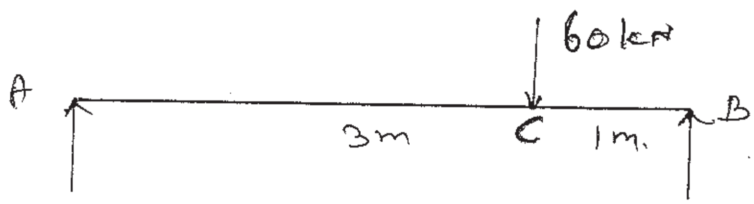


Fig. Q. 11. a) ii

(OR)

b) i) Find the diameter of the shaft for the following data, length of the shaft 2 m, permissible shear stress 75 N/mm$^2$. Shear modulus is $8 \times 10^4$ N/mm$^2$. Strain energy stored by the shaft is 88 Nm. **(6)**

ii) Calculate the deflection at the free end of the beam shown in Fig Q.11.b.ii. Using Castigliano's theorem, Let, EI = 4.9 MNm$^2$. **(7)**

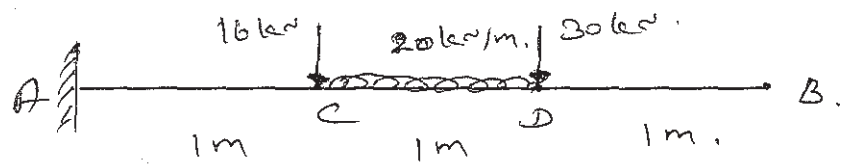


Fig Q.11. b. ii.

12. a) Determine the reactions at the supports and draw S.F and B.M diagrams for the propped cantilever beam shown in Fig.Q.12.a.

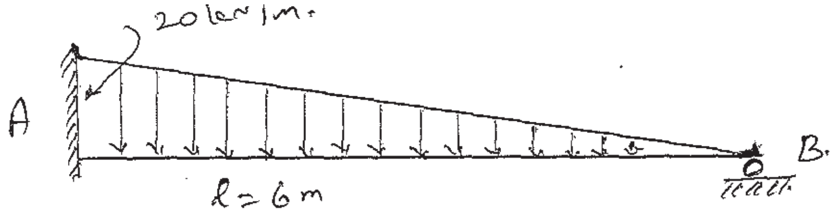


Fig. Q. 12. a.

(OR)

b) Draw S.F and B.M diagrams for the continuous beam of Fig.Q.l2.b.

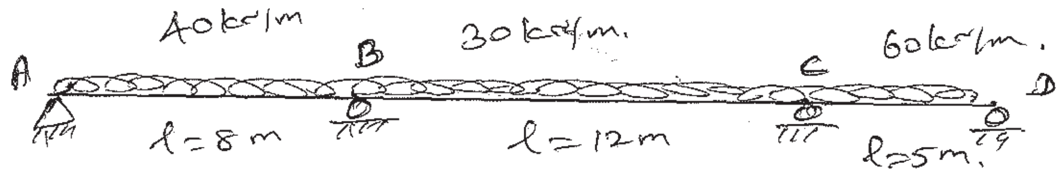


Fig. Q. 12. b.

13. a) i) Find the crippling load for a T section of flange 10 cm × 2 cm and web of 8 cm × 2 cm and of length 5 m, used as column with both of its ends hinged Let E = 2 × $10^5$ N/$mm^2$. **(8)**

ii) A column is rectangular in cross section of 300 mm × 400 mm in dimensions. The column carries an eccentric point load of 360 kN on one diagonal at a distance of quarter diagonal length from a corner. Calculate the maximum compressive stress at the corner. **(5)**

(OR)

b) A column of circular section is subjected to a load of 120 kN. The load is parallel to the axis but eccentric by an amount of 2.5mm. The external and internal diameters of columns are 60 mm and 50 mm respectively. If both the ends of the column are hinged and column is 2.1 m long, then determine the maximum stress in the column. Take E = 200 GN/$m^2$.

14. a) i) A MS flat, 450 mm × 40 mm × 30 mm. shown in Fig.Q.14. a. is subjected to axial tensile and compressive forces. Find the change in dimension and the change in volume. Let, E = 210 GN/$m^2$, m = 3.03. **(10)**

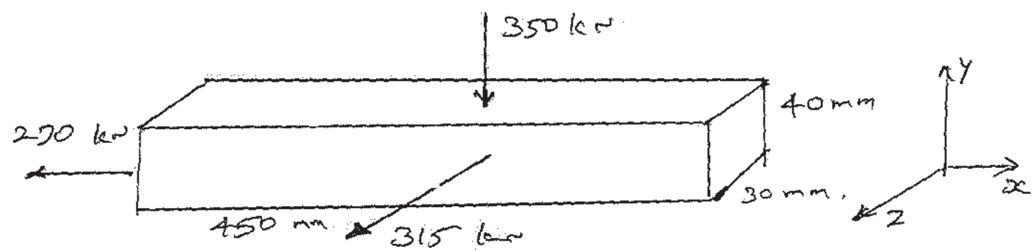


Fig. Q. 14. a.

ii) The principal stresses at a point in an elastic material are 100 N/$mm^2$ (tensile), 80 N/$mm^2$ (tensile) and 50 N/$mm^2$ ( compressive). If the stress at the elastic limit in simple tension is 200 N/$mm^2$, determine whether the failure of materials will occur according to maximum principal stress theory. If not, then determine the factor of safety. **(3)**

(OR)

b) A hollow mild steel shaft having 100 mm external diameter and 50 mm internal diameter is subjected to a twisting moment of 8 kN.m and a bending moment of 2.5 kN.m. Calculate the principal stresses and find direct stress which, acting alone would produce the same maximum elastic strain energy as that produced by the principal stresses acting together. Take Poisson's ratio = 0.25.

15. a) A beam of T-section (flange : 100 mm × 20 mm; web: 150 mm × 10 mm) is 3 m in length and is simply supported at the ends. It carries a point load of 4 kN at the center of the span and inclined at 20° to the vertical and passing through the centroid of the section. If E = 200 GN/$m^2$, calculate maximum compressive stress.

(OR)

b) i) A channel section has flanges l5 cm × 2 cm and web 20 cm × 1 cm. Determine the shear centre of the channel. **(3)**

ii) Fig.Q.15. b.ii) shows a ring carrying a load of 30 kN. Calculate the stresses at point 1. **(10)**

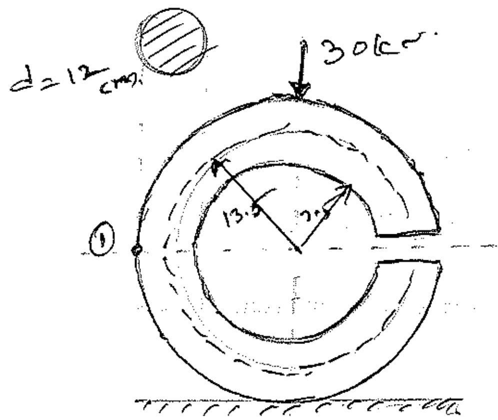


Fig. Q. 15 b. ii.

PART – C **(1×15 =15 Marks)**

16. a) Find the vertical deflection of joint $U_1$ of the truss shown in Fig. Q.16.a. due to applied load . The figure in parenthesis has shown the area of cross section of the members. Let E = 200 GN/$m^2$.

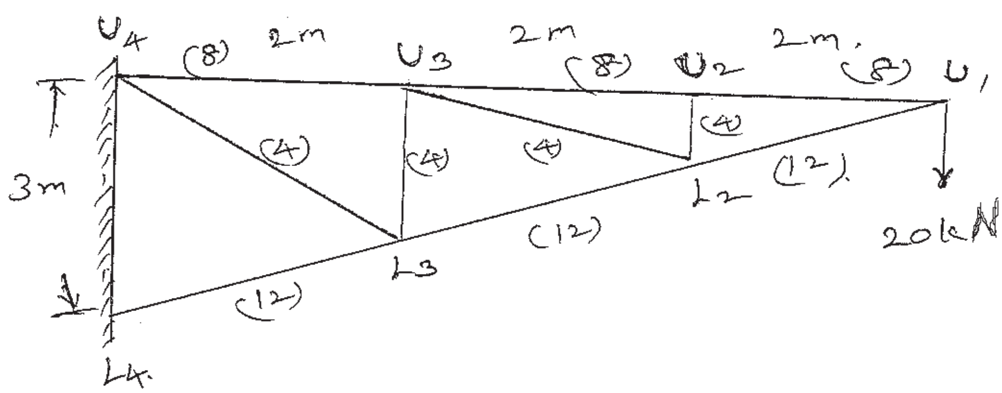


Fig. Q. 16. a.

(OR)

b) A steel cylinder of 1000 mm inside diameter is to be designed for an internal pressure of 4.8 MN/$m^2$. Calculate (i) the thickness if the maximum shearing stress is not to exceed 21 MN/$m^2$. (ii) The increase in volume, due to working pressure, if the cylinder is 7 m long with closed ends. Take E = 200 GN/$m^2$ and Poissons ratio = 1/3.