(b) A cured bar of rectangular section, initially unstressed is subjected to bending moment of 2000 N-m tends to straighten the bar. The section is 5 cm wide and 6 cm deep in the plane of bending and mean radius of curvature is 10 cm. Find the position of neutral axis and the stress at the inner and outer face.

PART C — (1 × 15 = 15 marks)

16. (a) The rectangular stress components of a point in three dimensional stress system are defined as a $\sigma_x = 20$ MPa, $\sigma_y = -40$ MPa, $\sigma_z = 80$ MPa, $\tau_{xy} = 40$ Mpa, $\tau_{yz} = -60$ MPa, $\tau_{xz} = 20$ MPa. Determine the principal stresses and principal planes.

Or

(b) From the following data of column and circular section, calculate the extreme stresses on the column section. Also find the maximum eccentricity in order that there may be no tension anywhere on the section.

External diameter = 20 cm, internal diameter = 16 cm, length of the column = 4 m, load carried by the column = 175 kN. Eccentricity of the load = 2.5 cm (from the axis of the column). End conditions = both ends fixed. Young's modulus = 94 GN/m².

Reg. No. :

Question Paper Code : 80079

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Civil Engineering

CE 8402 — STRENGTH OF MATERIALS — II

(Regulation 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the terms Resilience and Proof Resilience.

2. State Maxwell's reciprocal theorem.

3. Write Clapeyron's three moment equation for continuous beams when flexural rigidity is same and supports are at same level.

4. Find the reaction at prop for a propped cantilever subjected to concentrated load at centre.

5. List out the limitations of Euler's theory of columns.

6. Calculate the bursting pressure for cold drawn seamless steel tubing of 50 mm inside diameter with 2 mm wall thickness. The ultimate strength of steel is 400 MN/m².

7. Define Principal stress.

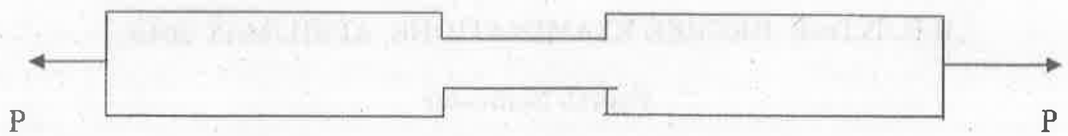
8. List out different theories of failure.

9. Define shear centre.

10. Define Principal moment of inertia.

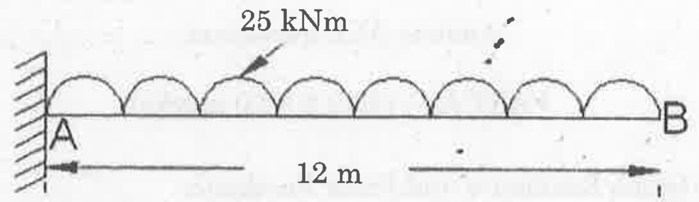
PART B — (5 × 13 = 65 marks)

11. (a) A 1.6 m long bar is applied an axial pull such that the maximum stress induced is 140 MPa. The larger and the smaller areas of cross section are 240 mm² and 120 mm². Determine strain energy stored in the bar. Take E = 200 GPa.

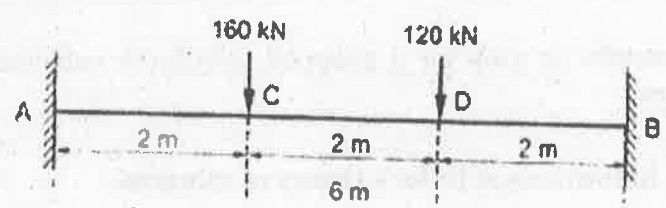


Or

(b) Determine vertical displacement at free end of a cantilever beam shown in fig. using method of virtual work. Take $E = 2\times10^5$ MPa and $I = 825\times10^7\ mm^4$.

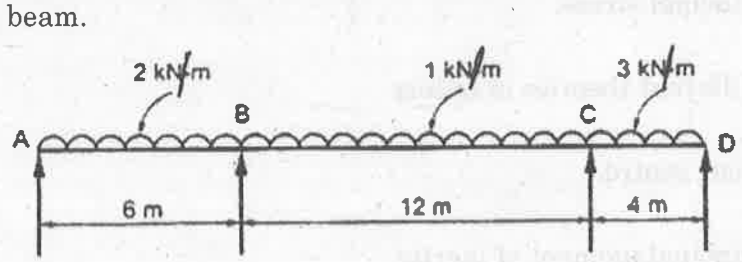


12. (a) A fixed beam AB of length 6 m carries point load of 160 kN and 120 kN at a distance of 2 m and 4 m from the left end A. Find the fixed end moments and the reactions at the supports. Draw Bending Moment and Shear Force diagrams.



Or

(b) A continuous beam consists of three successive spans of 6 m and 12 m and 4 m and carries load of 2 kN/m, 1 kN/m and 3 kN/m respectively on the spans. Draw Bending Moment Diagram and Shear Force Diagram for the beam.

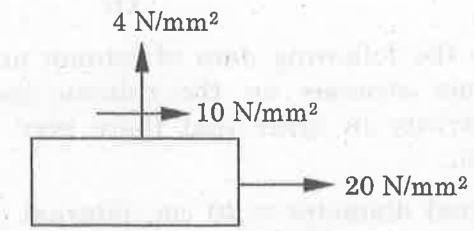


13. (a) Determine the shortest length for a pin jointed column of cross section 75 mm × 48 mm using Euler's formula. Take critical stress value as 220 MPa and E = 205 GPa.

Or

(b) A cast iron pipe has 20 mm internal diameter and 50 mm metal thickness, and carries water under a pressure of 5 N/mm². Calculate the maximum and minimum intensities of circumferential stress and sketch distribution of circumferential stress intensity and the intensity of radial pressure across the section.

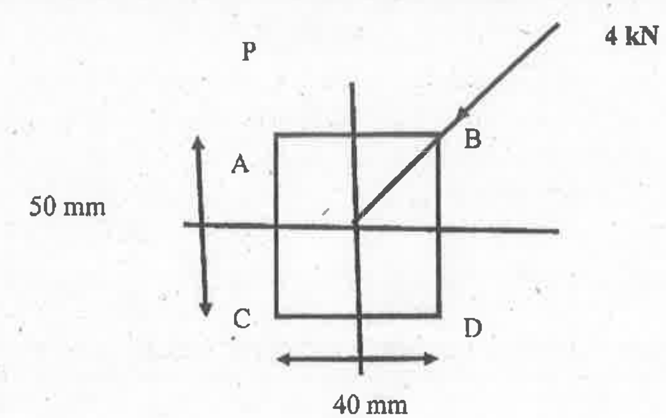
14. (a) For the state stress shown in fig. Find the principal plane and principal stress and maximum shear stress.



Or

(b) A steel shaft is subjected to an end thrust producing a stress of 90 MPa and the maximum shearing stress on the surface arising from the torsion is 60 MPa. The yield point of the material is simple in simple tension was found to be 300 MPa. Calculate the factor of safety of the shaft according to (i) Maximum shear stress theory (ii) Maximum distortion energy theory.

15. (a) Calculate the stresses at the corners of the rectangular section of a simply supported beam of span 5 m which carries a load of 4 kN at the centre of the span. The load line is inclined at an angle of 30° to the vertical longitudinal plane as shown in figure and passes through the centroid of the section. The dimensions of the section are shown.



Or

PART – C (1×15=15 Marks)

16. a) A steel tube of 300 mm external diameter is to be shrunk on to another steel tube of 90 mm internal diameter. After shrinking the diameter at the junction is 180 mm. Before shrinking on the difference of diameter at the junction is 0.12 mm. Find : i) The radial pressure at the junction ; ii) The circumferential stresses developed in the two tubes after shrinking on. Take E = 200 GN/m^2.

(OR)

b) Using Castigliano's theorem determine the horizontal and vertical displacements of the free end D in the frame shown in Fig.Q.No. 16 (b). Take EI = 12×10^{13} Nmm^2.

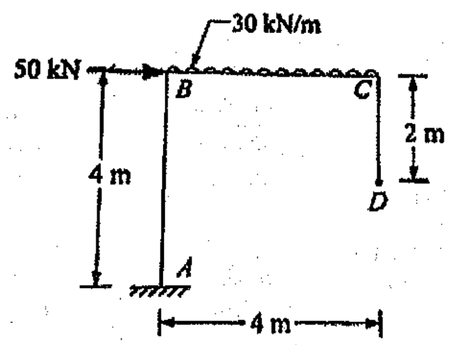


Fig.Q.No. 16 (b)

Reg. No. :

Question Paper Code : 90121

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fourth Semester

Civil Engineering

CE 8402 : STRENGTH OF MATERIALS – II

(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. Recall Castigliano's first theorem.
2. List the causes of lack of fit in plane frames.
3. The right support of a fixed beam of 6m span sinks by 15 mm. Calculate the moment caused due to sinking of support. Take E = 2×10^5 N/mm^2 and I = 40×10^5 mm^4.
4. Determine the fixed end moments at the ends of a beam 4m long carrying a clockwise couple 'M' at the midspan.
5. Categorize loaded columns based on their end conditions.
6. Determine the Modulus of Rigidity of a thick cylinder made of a material having a Young's Modulus of 203GN/m^2 and Poisson's ratio of 0.287.
7. Recall Maximum Principal Strain Theory.
8. Comment on the failure criteria based on Maximum Principal Stress Theory.
9. Outline the two reasons of unsymmetrical bending of beams.
10. Mention the assumptions made in the analysis of curved beams using Winkler-Bach Theory.

PART – B (5×13=65 Marks)

11. a) A uniform metal bar has a cross-sectional area of 7 cm^2 and a length of 1.5 m. With an elastic limit of 160MN/m^2, what will be its proof resilience ? Determine also the maximum value of an applied load which may be suddenly applied without exceeding the elastic limit. Calculate the value of gradually applied load which will produce the same extension as that produced by the suddenly applied load above. Take E = 200 GN/m^2.

(OR)

b) A crane structure attached to a vertical wall and carrying a vertical load of 20 kN at C as shown in Figure Q.No. 11 (b). All tension members are stressed to 80N/mm^2 and all compression members to 50N/mm^2. Determine horizontal and vertical deflection of end C using unit load method. Take E = 2×10^5 N/mm^2. All members, except CD, have a length of 2m.

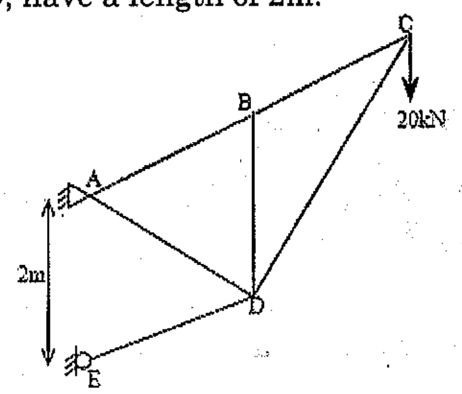


Fig. Q.No. 11 (b)

12. a) A simply supported continuous beam ABCD covers three spans, AB = 1.5 L, BC = 3L and CD = L. It carries uniformly distributed loads of 2w, w and 3w per meter run on AB, BC and CD respectively. If the girder is of the same cross-section throughout, find the bending moment and shear force at supports. Also plot bending moment and shear force diagrams using the theorem of three moments.

(OR)

b) A beam ABCD with simply supported ends, 16m long is continuous over three spans ; AB = 6m, BC = 5m and CD = 5m, the supports being at the same level. There is a uniformly distributed load of 20 kN/m over BC. On AB, there is a point load of 80kN at 2m span from A. On CD, there is a point load of 60 kN at 3m from D. Using theorem of three moments calculate the moments and reactions at the supports and draw bending moment and shear force diagrams.

13. a) A simply supported built-up beam of symmetrical I section has the following dimension. Flanges 30cm × 5cm and web 100cm × 2cm. Compute its length, given that when it is subjected to a load of 40 kN per metre length, it deflects by 1 cm. Find out the safe load, if this beam is used as a column with both ends fixed. Assume a factor of safety of 4. Use Euler's formula. E = 210GN/m^2.

(OR)

b) A cylindrical shell 3m long which is closed at the ends has an internal diameter of 1 m and a wall thickness of 15mm. Calculate the circumferential and longitudinal stresses induced and also change in dimensions of the shell if it is subjected to an internal pressure of 1.5MN/m^2. Take E = 200GN/m^2 and 1/m = 0.3.

14. a) In a material the principal stresses are 60 MN/m^2, 48MN/m^2 and -36MN/m^2. Take E = 200GN/m^2 and 1/m = 0.3 and calculate : i) Total strain energy ; ii) Volumetric strain energy ; iii) Shear strain energy ; and iv) Factor of safety on the total strain energy criterion if the material yields at 120 MN/m^2.

(OR)

b) A bolt is under an axial thrust of 9.6 kN together with a transverse force of 4.8 kN. Given factor of safety = 3, yield strength of material of bolt = 270 N/mm^2 and Poisson's ratio = 0.3, calculate its diameter according to i) Maximum principal stress theory; ii) Maximum shear stress theory ; and iii) Strain Energy Theory.

15. a) A simply supported beam of T-section (flange : 100 mm × 20 mm ; web : 150 mm × 10 mm) is 2.5 m in length. It carries a load of 3.2 kN inclined at 20° to the vertical passes through the centroid of the section. If E = 200 GN/m^2 calculate : i) Maximum tensile stress ; ii) Maximum compressive stress ; iii) Deflection due to the load ; and iv) Position of the neutral axis.

(OR)

b) A curved frame shown in Figure Q. 15(b) is subjected to a load of 2.4 kN. Determine the resultant stresses at points 1 and 2 and also the position of the neutral axis.

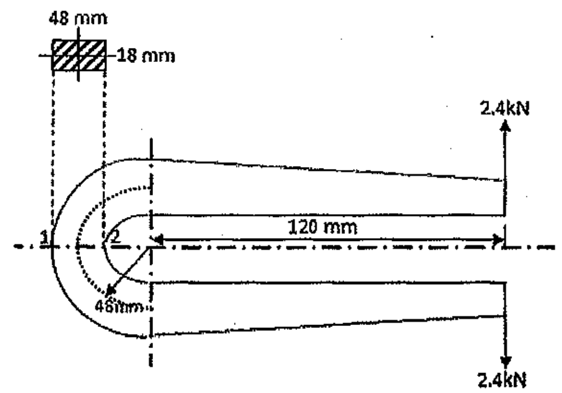


Fig. Q.No. 15 (b)