1501

April 2025

Time – Three hours
(Maximum Marks: 100)

[*N.B.* Answer all the questions, choosing any two subdivision from each question. Each subdivision carries 10 marks.]

1. (a) A cantilever beam of 1m long is rectangular section of width 200mm and depth 450mm. Calculate the maximum udl that can be allowed over the entire length of beam without exceeding a deflection of 4.5mm at the free end. Take E= 7.5×10^4 N/mm^2.

(b) A cantilever beam of 5m length carries two point loads 5 kN and 15 kN at free end and 2m from fixed end respectively. Find the maximum slope and deflection at the free end. Take E=210 kN/mm^2 and I=6×10^8mm^4.

(c) (i) State Mohr's theorem I & II.
(ii) What is elastic curve? Draw elastic curve for any two beams.

(d) A simply supported beam 150mm x 300mm size with 6m span carries an udl of 40kN/m throughout the span. Find the maximum slope and deflection of the beam. Take E=2.0×10^5 N/mm^2.

2. (a) A fixed beam AB of length 6m is subjected to an udl of 'w' kN/m over its entire span. The net bending moment at mid span is 45kNm. Determine the value of 'w'.

(b) A fixed beam AB of length 6m carries an udl of 40 kN/m over its entire span. In addition to udl a point load of 100 kN is acting at its mid span. Determine the fixed end moments. Draw SFD and BMD.

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(c) A fixed beam AB of length 9m carries two point loads of 100 kN each at one-third points. Determine the fixed end moments. Draw SFD and BMD.

(d) (i) Define sagging and hogging bending moment.

(ii) Write about fixed BMD and point of contraflexure.

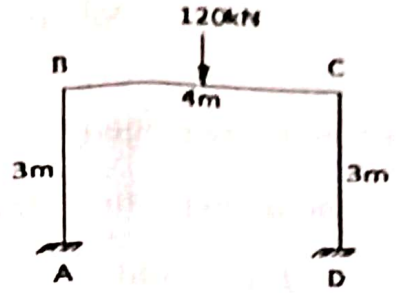
3. (a) A continuous beam ABC of 12m length has two equal spans. The span AB carries a point load of 40 kN at mid span. The span BC carries a point load of 60kN at mid span. The supports A and C are simply supported. Draw SFD and BMD. Use Clapeyron's theorem.

(b) A two span continuous beam AB=6m and BC=5m, the supports A and C are simply supported. The span AB carries a point load of 80kN at mid span. The span BC carries an udl of 40 kN/m over its entire length. Draw SFD and BMD. Use theorem of three moments method.

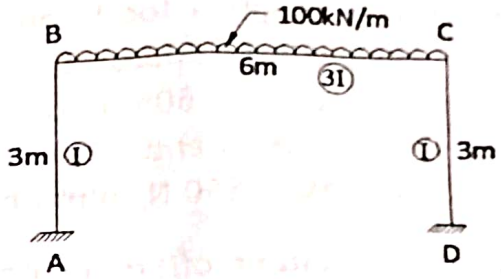
(c) A two span continuous beam AB=5m and BC=7m. The support A is simply supported and support C is fixed. The span AB carries an udl of 25kN/m over its entire length. The span BC carries a point load of 35kN at 3m from support B. Draw SFD and BMD. Use theorem of three moments method.

(d) A continuous beam ABC of 8m length has two equal spans. The span AB carries an udl of 15kN/m over its entire length and span BC carries an udl of 30 kN/m over its entire length. The supports A is fixed and C is simply supported. Draw SFD and BMD. Use Clapeyron's theorem.

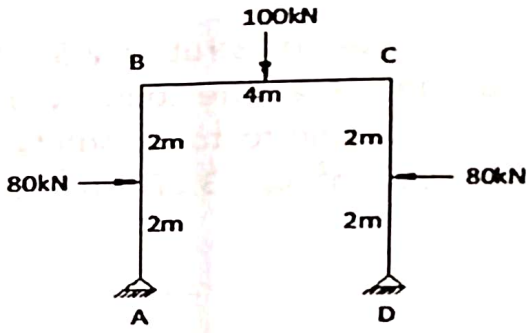
4. (a) Analyze the portal frame loaded as shown in figure by Moment distribution method. Draw BMD. Take EI as constant.



(b) Analyze the portal frame loaded as shown in figure by Moment distribution method. Draw BMD.



(c) Analyze the portal frame loaded as shown in figure by Moment distribution method. Draw BMD. Take EI as constant.



(d) (i) What is meant by sway and non sway frame?

(ii) Define distribution factor and distribution moment.

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5. (a) A steel bar of 3.8 m long, 50mm diameter is used as strut. Calculate the Euler's crippling load for the following end conditions:

(i) When both ends are hinged,

(ii) When one end is hinged and other fixed,

(iii) When both ends are fixed,

(iv) When one end is fixed and other end is free.

Take $E=2.10 \times 10^5$ N/mm^2.

(b) Find the ratio of crippling loads given by Euler's and Rankine's formula for a cast iron tubular column 4.2m long having inner and outer diameter of 160mm and 200mm, respectively. The column is hinged at both ends. Take Rankine's constant = 1/1600 and yield point stress = 550 N/mm^2 and $E = 2.0 \times 10^5$N/mm^2.

(c) A hollow circular column of 5m length is fixed at both ends has to support an axial load of 600 kN. The internal diameter is 0.75 times the external diameter. Allowing a factor of safety of 2.5, calculate the external & internal diameters and thickness of the column. Use Euler's formula. Take $E=2.0 \times 10^5$ N/mm^2.

(d) An ISJB 150 is used as strut of 2.5m length with both ends are pinned. Calculate the safe load by using Euler's formula. Take $E=2.1 \times 10^5$ N/mm^2 and factor of safety = 4. The properties of ISJB 150 are: A= 901mm^2, $I_{xx} = 3.22 \times 10^6$mm^4 and $I_{YY} = 9.2 \times 10^4$mm^4.
