STRUCTURAL ANALYSIS - II
(CIVL 3101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

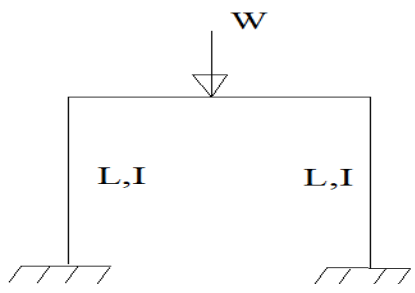
Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The portal frame shown below will

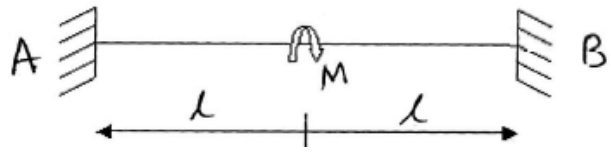


(a) No sway (b) Sway towards left
(c) Sway towards right (d) Sway either to left or right.

(ii) The moment required to rotate the near end of a prismatic beam through an unit angle without translation, the far end being simply supported, is given by
(a) $\frac{3EI}{L}$ (b) $\frac{4EI}{L}$ (c) $\frac{2EI}{L}$ (d) $\frac{EI}{L}$.

(iii) When the far end of the beam member is hinged, carry over factor at the far end is
(a) 0.05 (b) 0.0 (c) 1.0 (d) none of these.

(iv) The fixed end moment M_{FAB} for the beam shown below is



(a) 0 (b) M/2 (c) M/4 (d) 2M.

(v) A suspension bridge with two hinged stiffening girder is statically
(a) Determinate (b) Indeterminate to 1 degree
(c) Indeterminate to 2 degree (d) Indeterminate to 3 degree.

(vi) For curved beams in plan, in addition to bending moment and shear force, torsional moments also acts because
(a) the c/s shape of the section is curved
(b) the beam is simply supported
(c) the c.g. of the loads and reactions to one side of any section, does not lie along the axis of the beams
(d) all of the above.

(vii) For unsymmetrical bending of beams
(a) the load line is coincident or parallel to the Principal axes.
(b) the load line is coincident to the principal axis but the section is unsymmetrical.
(c) the load line is inclined to the principal axes but the section is symmetrical.
(d) either option (a) or (b).

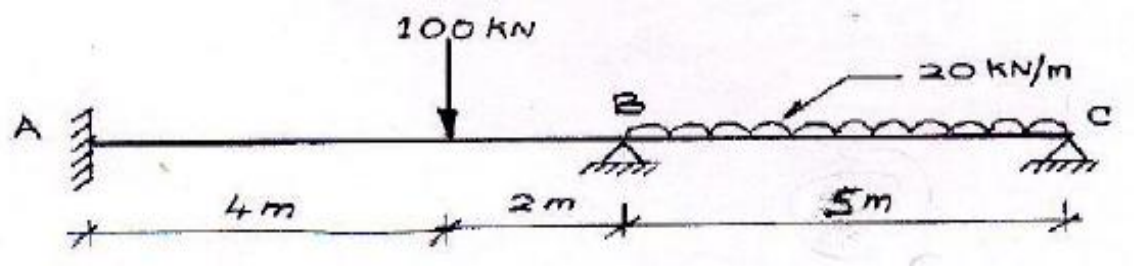
(viii) If the number of possible plastic hinges are 4 and the degree of indeterminacy of the structure is 2, then the number of possible independent mechanism(s) 'n' will be
(a) 6 (b) 4 (c) 2 (d) 1

(ix) In plastic analysis, the shape factor for a circular section is
(a) 1.5 (b) 1.6 (c) 1.7 (d) 1.8

(x) Stiffness coefficient 'k_{ij}' is defined as
(a) The force developed at joint 'i' due to unit force at joint 'j' while all other joints are fixed.
(b) The force developed at joint 'i' due to unit displacement at joint 'j' while all other joints are fixed.
(c) The displacement developed at joint 'i' due to unit force at joint 'j' while all other joints are fixed.
(d) The displacement developed at joint 'i' due to displacement force at joint 'j' while all other joints are fixed.

Group - B

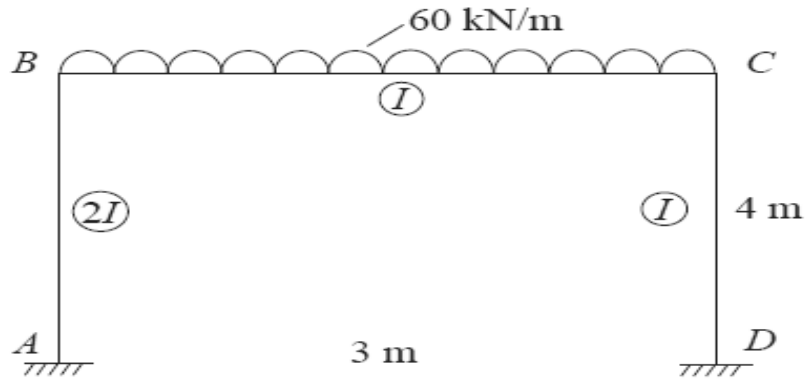
2. (a) Evaluate two span continuous beam ABC by Slope-deflection method.
[(CO1)(Evaluate/HOCQ)]



(b) The two hinged stiffening girder of a suspension bridge have a span of 80 m, the height of the supporting cable being 8 m. If the girder is subjected to two point loads 200 kN and 400 kN at a distance of 20 m and 80 m from the left end. Find the maximum tension in the cable. [(CO2)(Evaluate/HOCQ)]

8 + 4 = 12

3. Analyse the portal frame by the Moment Distribution method. Draw the bending moment diagram.
[(CO1)(Analyze/IOCQ)]



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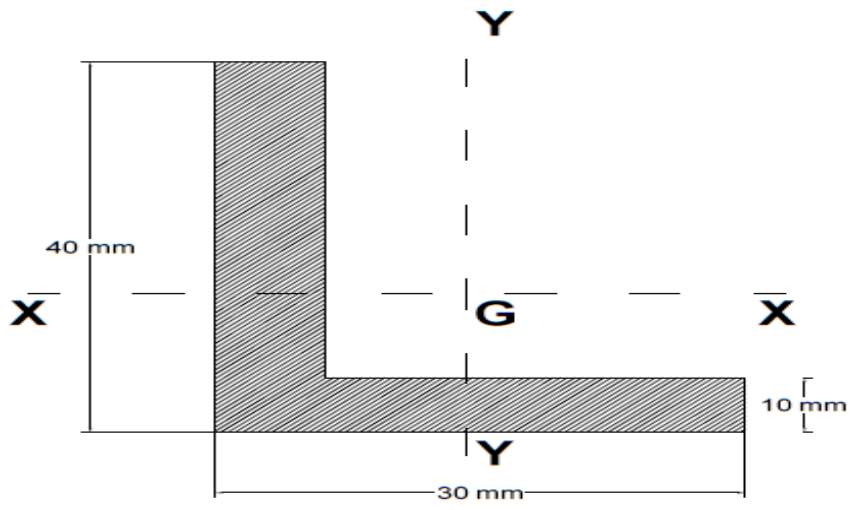
Group - C

4. (a) A quarter circle beam of radius R curved in plan is fixed at end A and free at end B. It carries a vertical load P at it's free end. Create the S.F., B.M. and torsional moment diagrams. Assume EI = 2GJ. [(CO4)(Evaluate/HOCQ)]

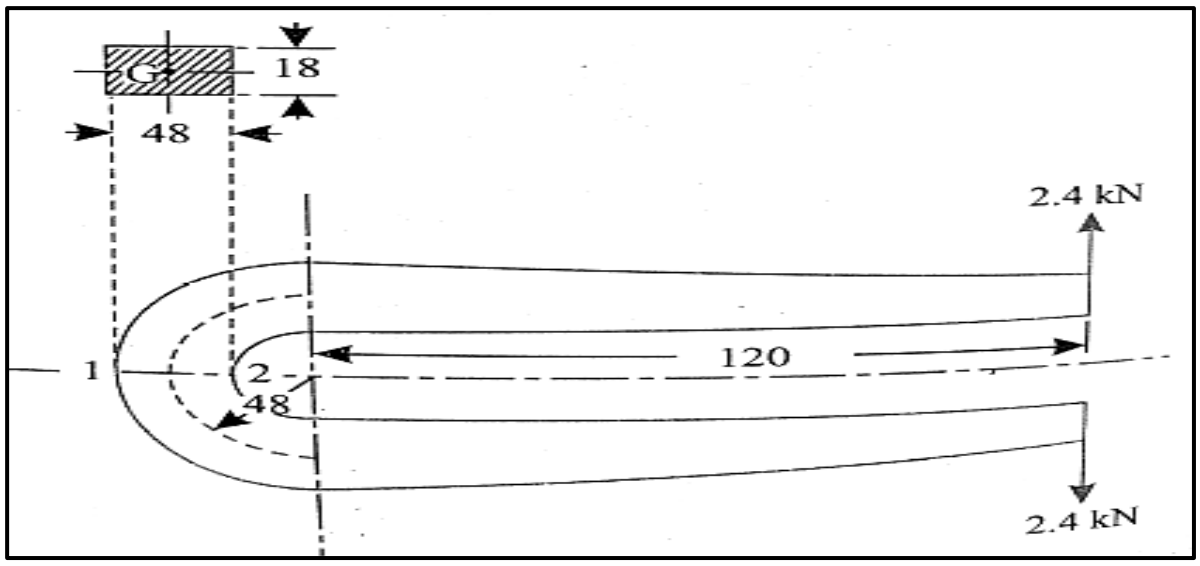
(b) A 40 mm × 30 mm × 10 mm unequal angle section is placed with the one leg vertical as shown in the adjacent figure. It is subjected to a sagging bending moment of 500 N-m on the horizontal axis. Measure the stresses induced at points P1 and P2. P1 is located at left top corner and P2 is located at right bottom corner.

[(CO4)(Evaluate/HOCQ)]



4 + 8 = 12

5. Analyze the curved bar using Winkler Basch Theory. The frame is subjected to a load of 2.4 kN. [(CO3)(Analyze/IOCQ)]



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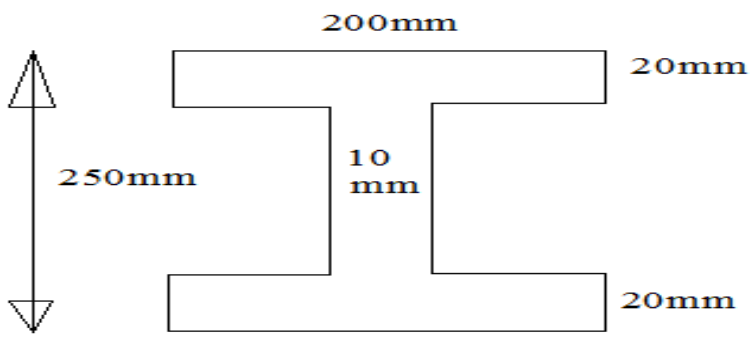
Group - D

6. (a) Determine the shape factor of I section shown in figure below:



200mm

[(CO4)(Evaluate/HOCQ)]

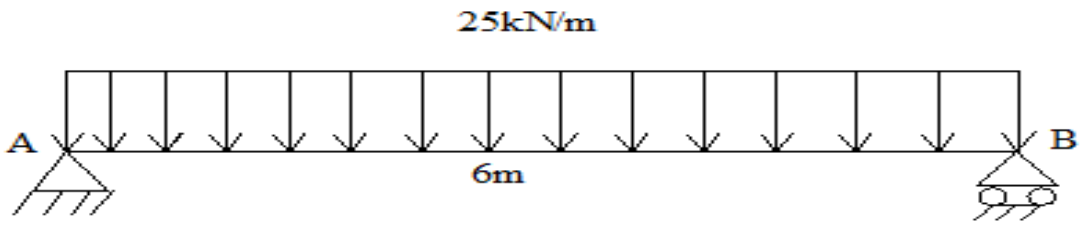
(b) A two span continuous beam ABC has a span of length AB = 6 m and BC = 6 m and carries a uniformly distributed load of 30 kN/m. A and C are simply supported. If the load factors 1.8 and the shape factor is 1.15 for the I section. Find the section modulus needed. [(CO3)(Evaluate/HOCQ)]

5 + 7 = 12

6. (a) Briefly describe the assumptions of "Fully Plastic Moment of the Section".

[(CO4)(Remember/LOCQ)]

(b) Determine the collapse load of a simply supported beam shown below:

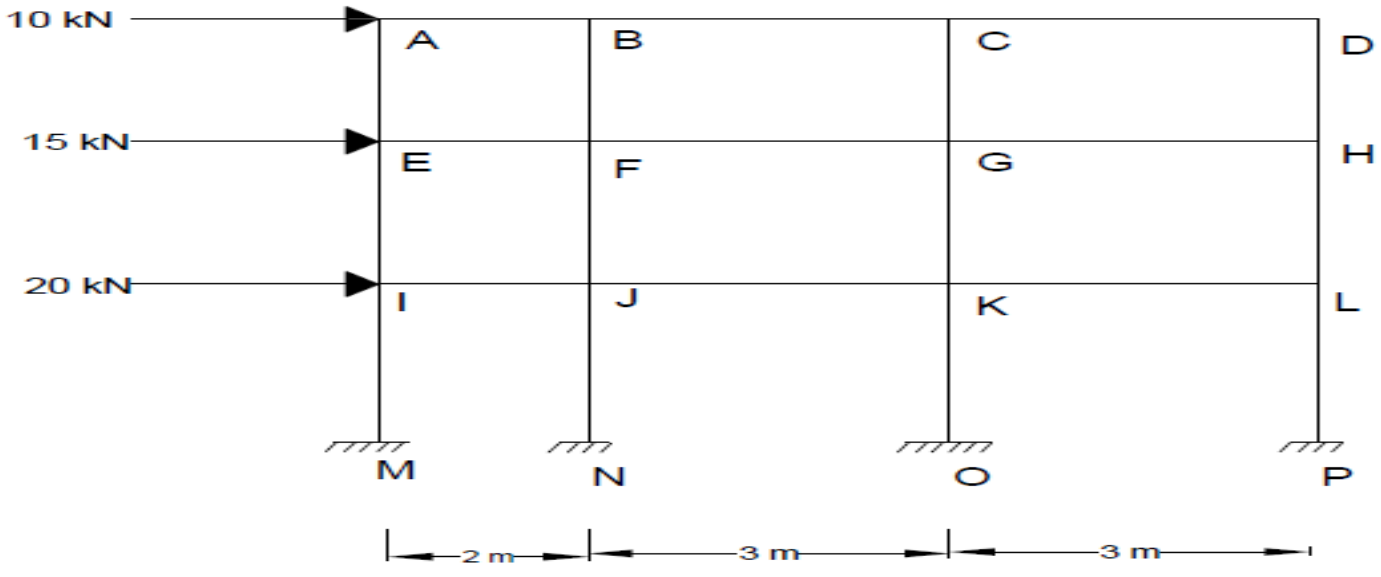


[(CO5)(Evaluate/HOCQ)]

4 + 8 = 12

Group - E

8. For the multi storey frame shown below in the figure, determine all the column-end and beam-end moments due to lateral loads as shown. The storey heights are 4m each. Analyse the frame using Portal method. [(CO6)(Create/HOCQ)]



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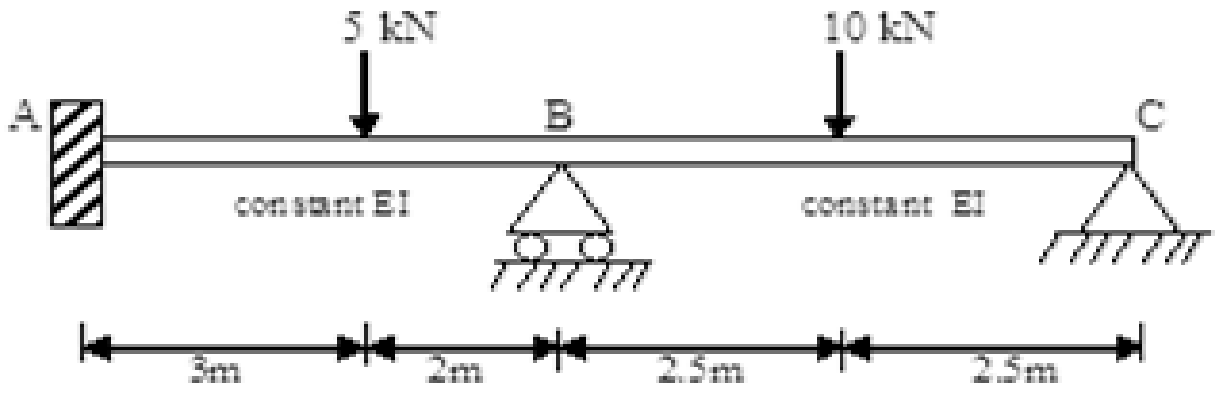
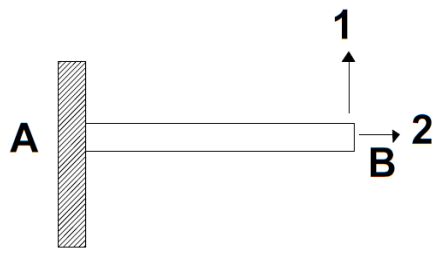
9. (a) Develop the flexibility matrix for the simply supported beam AB with coordinate system shown in the figure below.
[(CO6)(Construct/IOCQ)]



(b) Compose the procedure to develop the stiffness matrix for the beam shown below.
[(CO6)(Construct/IOCQ)]



6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	4.17	37.50	58.33

Course Content (CO):

After the completion of the course students will be able to:

1. Apply the Slope Deflection and Moment Distribution.
2. Develop and analyze the concept of suspension bridge and stiffness girders.
3. Apply and analyze the concepts of curved beam analysis in hooks, rings and Bow girders.
4. Develop the concept bending in unsymmetrical beams.
5. Develop the fundamental concepts of plastic analysis using kinematic method and apply them in frames and continuous beam analysis.
6. Develop and analyze the portal frames using Portal and Cantilever method. Develop and analyze the indeterminate structures (continuous beams and frames) using flexibility and stiffness matrix method.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question