STRUCTURAL ANALYSIS - II
(CIVL 3101)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

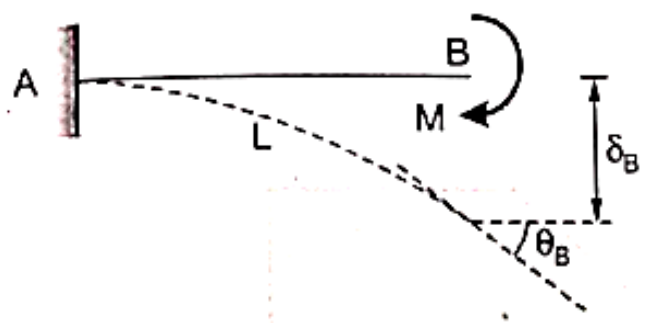
(i) The flexibility matrix relates
(a) displacements to forces
(b) stresses to strains
(c) loads to reactions
(d) moment to curvature.

(ii) In curved beam, the neutral axis is located
(a) at the centroid of the cross-section
(b) closer to the side with a larger radius of curvature
(c) closer to the side with a smaller radius of curvature
(d) at the innermost fibre of the cross-section.

(iii) A propped cantilever beam AB of span L is subjected to a moment M at the prop end B. The moment at fixed end A is
(a) 2M (b) M/2 (c) M (d) 3M/4

(iv) Slope at free end of the cantilever is

(a) $\Theta_B = ML$
(b) $\Theta_B = ML/2EI$
(c) $\Theta_B = ML/3EI$
(d) $\Theta_B = ML/EI$

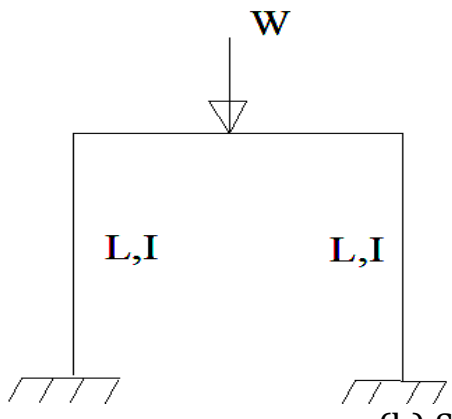


(v) For approximate analysis of building frames under horizontal loads, the point of inflection is assumed at
(a) centre of each beam
(b) centre of each column
(c) one-tenth of the span length from each end of the beam
(d) both (a) and (b)

(vi) 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) $\frac{EI}{L}$

(vii) 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

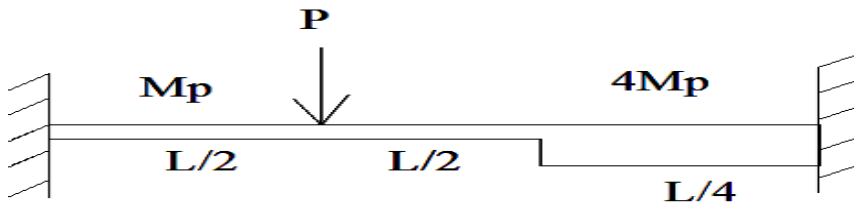
(viii) The portal frame shown below will



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

(ix) In cantilever method, the basic deformation in the frame is
(a) torsion with shear
(b) torsion along with bending
(c) bending and not shear
(d) only in shear.

(x) For the beam shown in fig the collapse load (P) is given by



(a) 16Mp/L (b) 14Mp/L (c) 12Mp/L (d) 10Mp/L

Fill in the blanks with the correct word

(xi) The cantilever method is commonly used for analyzing structures with _____ loading conditions.

(xii) A rigid fixed beam of span 'l' carries an udl of 'w' per unit, the fixed end moment is _____.

(xiii) Unsymmetrical bending occurs when the applied loads do not lie in the _____ of the cross-section.

(xiv) Carryover Moment at end B due to moment M applied at end A for the given propped cantilever beam is _____.

(xv) Bending moment at any section in a conjugate beam gives in the actual beam_____.

Group - B

2. (a) Analyze two span continuous beam ABC as shown in Fig.1 by Slope-deflection method.

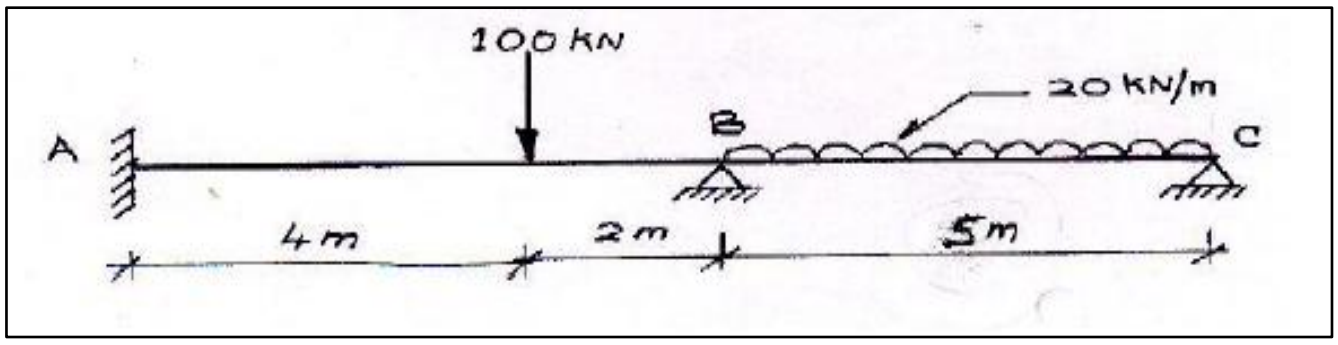


Fig.1

[(CO1)(Analyse/HOCQ)]

(b) The three hinged stiffened girder of a suspension bridge of span 120 m is subjected to two point loads of 240 kN and 300 kN at a distance of 25 m and 80 m from left end. Find the shear force and bending moment for the girder at a distance of 40m from left end. The supporting cable has a central dip of 12 m. Find the maximum tension in cable.

[(CO2) (Apply/IOCQ)]

8 + 4 = 12

3. Analyse the portal frame as shown in Fig.2 by the Moment Distribution method. Draw the bending moment diagram.

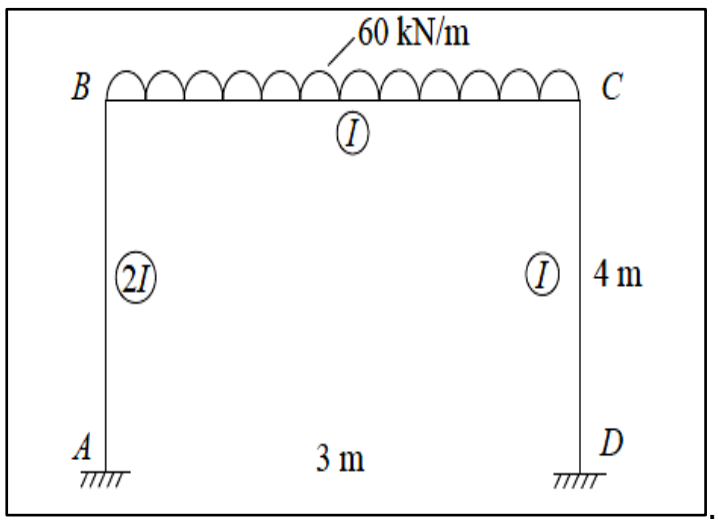


Fig.2

[(CO1)(Analyse/HOCQ)]

12

Group - C

4. A rectangular beam is subjected to unsymmetric bending as shown in Fig.3. The value of the bending moment applied is 900 kN-m and it is applied at angle 30^0 from y-y axis which is a symmetrical axis. The sides AB=CD=150 mm and the sides BC= AD=140 mm. Find bending stress (σ) at each corner of the beam. *[(CO3)(Analyse/HOCQ)]*

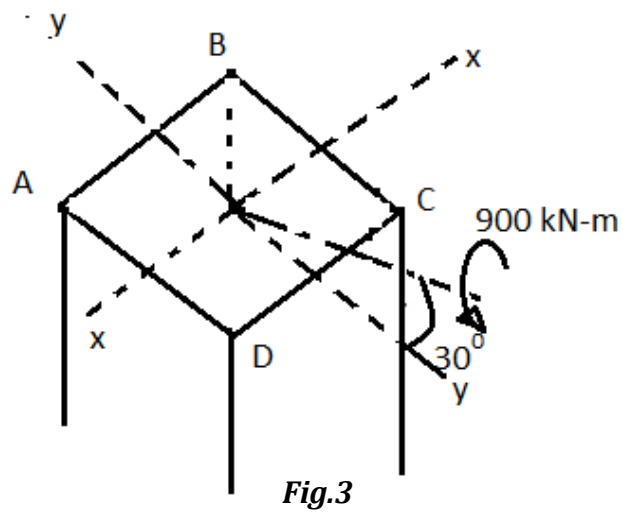


Fig.3

12

5. A semicircular curved bar is loaded as shown in Fig.4 and has the trapezoidal cross section shown in Fig.5. Calculate the tensile stress at point 1 of if r_1=b=h=3 cm and p=600 kg.

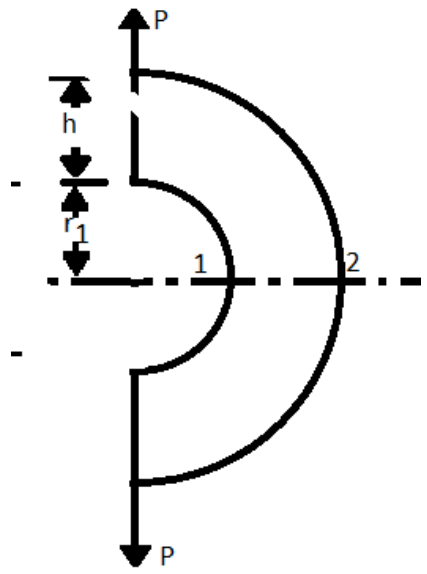


Fig.4

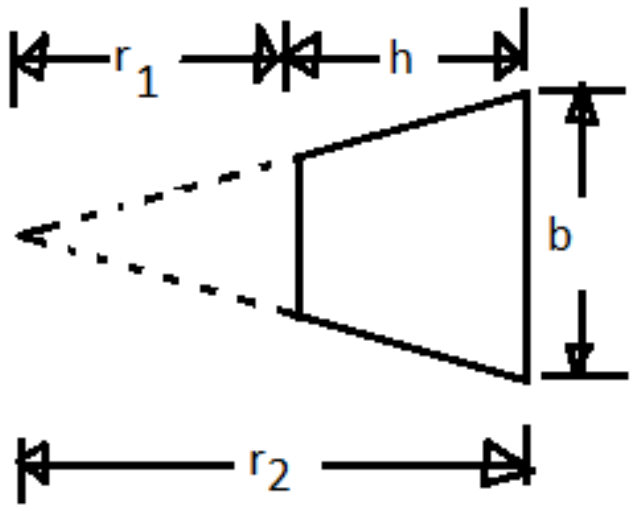


Fig.5

[(CO3)(Analyse/HOCQ)]

12

Group - D

6. (a) Briefly describe the various steps of "Plastic Bending of a beam section" with a neat diagram. *[(CO3)(Remember/LOCQ)]*

(b) A continuous beam ABC is loaded as shown in Fig.6. Determine required M_p if the load factor is 3.2.

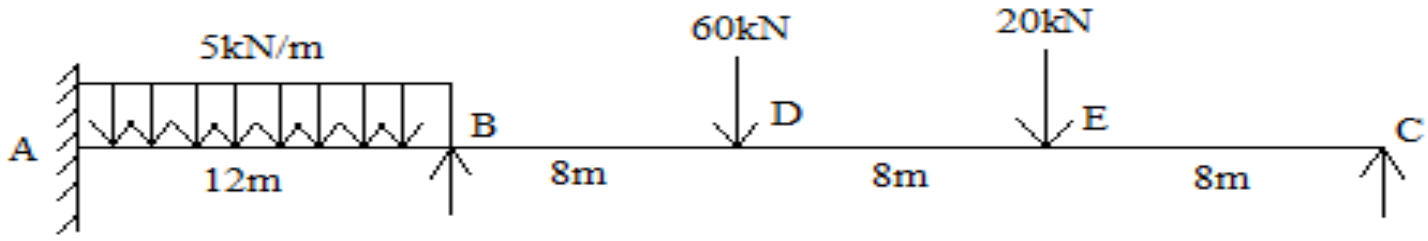


Fig.6

[(CO3)(Analyse/HOCQ)]

5 + 7 = 12

7. (a) A mild steel I-section of 100 mm wide and 150 mm deep has a mean flange thickness of 20 mm and a web thickness of 10 mm. Calculate the shape factor. Find the fully plastic moment if σ_y=252 N/mm^2. *[(CO5)(Analyse/HOCQ)]*

(b) Find the collapse load for the frame shown in Fig.7.

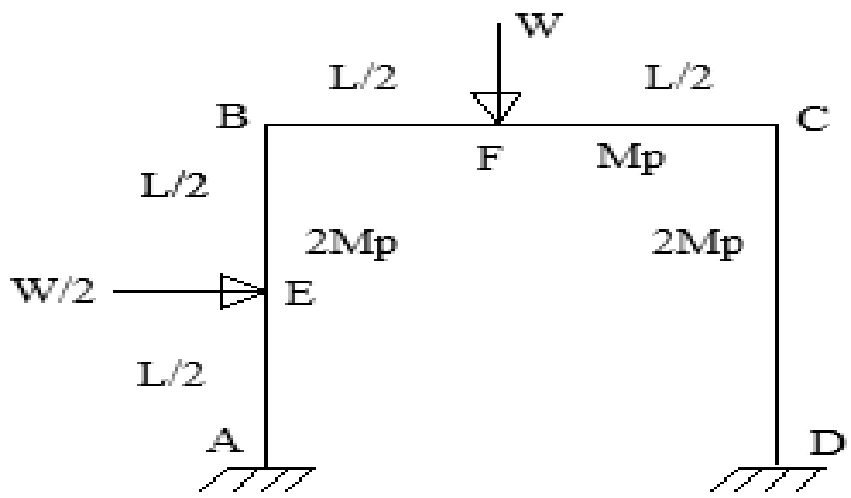


Fig.7

[(CO3)(Apply/IOCQ)]

4 + 8 = 12

Group - E

8. Determine (approximately) the reactions at the base of the columns of the frame shown in Fig.8. Use the portal method of analysis.

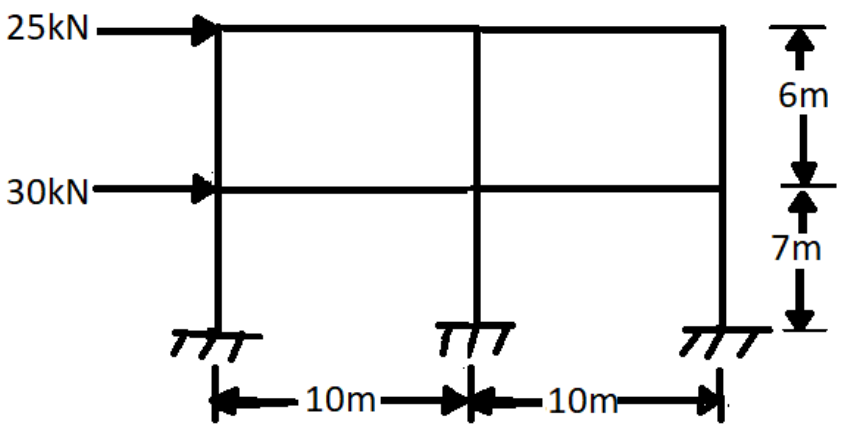


Fig.8

[(CO3)(Apply/IOCQ)]

12

9. Develop the stiffness matrix for the given co-ordinate. The length of the cantilever beam as shown in Fig.9 is L, area is A, modulus of elasticity is E and moment of inertia is I.

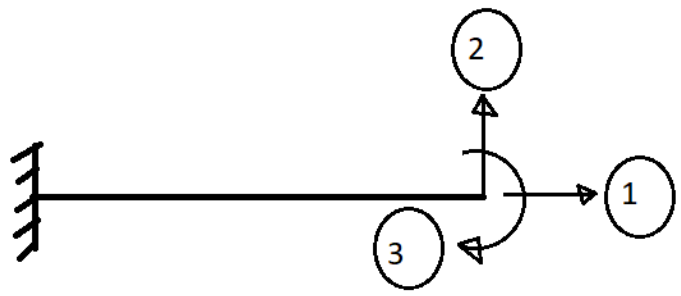


Fig.9

[(CO2)(Apply/IOCQ)]
12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	5.21	37.5	57.29

Course Outcome (CO):

After the completion of the course students will be able to
1. Apply the Slope Deflection and Moment Distribution Method to analyze indeterminate structures.
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 subjected to lateral loads using portal and cantilever methods and matrix method of structural analysis.

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