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.

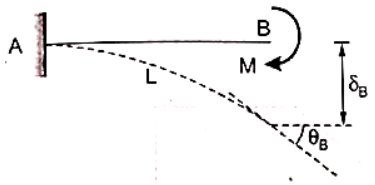
Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

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

(i) In slope deflection equation, the deformation is considered to be caused by:
(a) Bending Moment (b) Shear Force
(c) Axial Force (d) All of the above

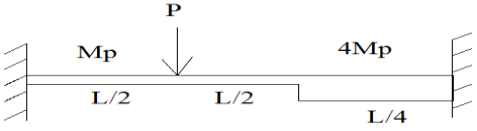
(ii) Moment at free end of the cantilever is:
(a) $\Theta_B = ML$
(b) $\Theta_B = ML/2EI$
(c) $\Theta_B = ML/3EI$
(d) $\Theta_B = ML/EI$



(iii) The absolute stiffness of a beam (EI constant) with one end hinged is:
(a) 2EI/L (b) 4EI/L (c)3EI/L (d) 6EI/L

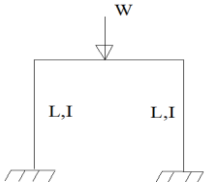
(iv) A suspension bridge with a two hinged stiffening girder is
(a) Statically Indeterminate (b) Indeterminate of one degree
(c) Indeterminate of two degree (d) A mechanism.

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



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

(vi) The portal frame shown below will



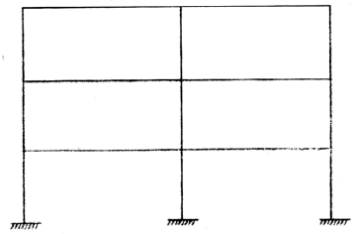
(a) No sway (b) Sway towards left
(c) Sway towards right (d) Sway either to left or right

(vii) Beams curved in plan are designed for:
(a) Bending Moment and shear force
(b) Shear force and Torsion
(c) Bending Moment and Torsion
(d) Bending Moment, Shear force and Torsion.

(viii) 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.

(ix) If the flexibility matrix is given as:
$[F] = \begin{bmatrix} 2 & -1 \\ -1 & 4 \end{bmatrix}$, then the corresponding Stiffness Matrix is:
(a) $[k] = \begin{bmatrix} 1.2 & 2.6 \\ 3.2 & 0.4 \end{bmatrix}$ (b) $[k] = \begin{bmatrix} 0.57 & 0.13 \\ 0.13 & 0.28 \end{bmatrix}$
(c) $[k] = \begin{bmatrix} 0.57 & 1.13 \\ 1.13 & 0.28 \end{bmatrix}$ (d) $[k] = \begin{bmatrix} 1.13 & 0.57 \\ 0.57 & 1.13 \end{bmatrix}$

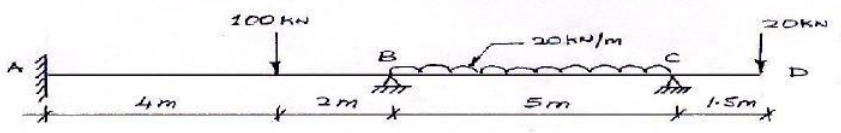
(x) The degree of static indeterminacy of the frame below is:



(a) 9 (b) 12 (c) 18 (d) None of these.

Group – B

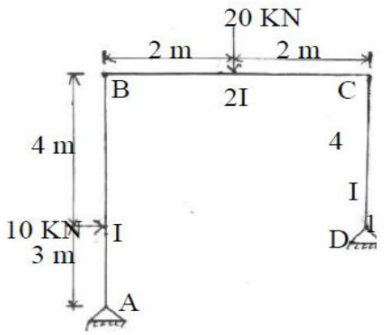
2. (a) Determine the support moments and reactions for the continuous beam shown in fig. by slope deflection method. Draw Shear force and Bending moment diagram. Assume EI is constant throughout the span.
[(CO1) (Remember/LOCQ)]



(b) The three hinged stiffened girder of a suspension bridge of span 120m is subjected to two point loads of 240kN and 300kN at a distance of 25m and 80m 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 12m. Find the maximum tension in cable. [(CO1) (Evaluate)/HOCQ]

6 + 6 = 12

3. Analyse the rigid frame by Moment Distribution method and draw the Bending Moment Diagram. [(CO1) (Evaluate/HOCQ)]



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Group – C

4. The fig. shows a 80 mm × 80 mm angle section having $I_{xx}=I_{yy}= 87.36 \times 10^{-8}$ m^4. It is used as freely supported beam with one leg vertical. On the application of the bending moment in the vertical plane YY the mid-section of the beam deflects in the direction AA' at $30^0 15'$ to the vertical. Calculate the following:-
   (i) Second moment of area of the section about it's principal axis.
   (ii) What is the bending stress at the corner B if the bending moment is 1.5 kN-m?
   [(CO4) (Evaluate/HOCQ)]

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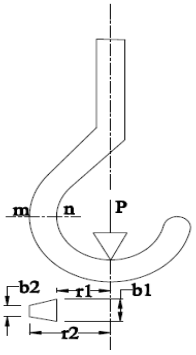
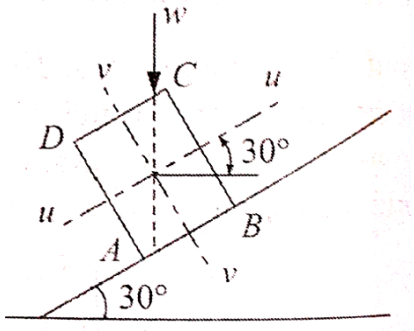
5. (a) A steel crane hook caries a load P = 1500 kg as shown in Fig.6. The cross section m-n of the hook is trapezoidal as shown in the figure. Find the total stresses σ_m and σ_n at points m and n. The following numerical data are given: b1 = 5 cm, b2 = 2 cm, r1 = 4 cm, r2 = 12cm.
   [(CO3) (Analyze/IOCQ)]



   (b) A wooden beam of cross section 100mmx150mm is used as shown in Fig. to support a sloping Mangalore tiled roof. It has an effective span of 4m and carries a uniformly distributed load of 3kN/m acting vertically downward. Determine the maximum stresses developed in the beam. [(CO4)(Evaluate/ HOCQ)]



6 + 6 = 12

Group – D

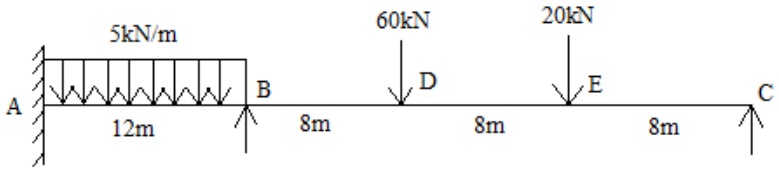
6. (a) Find shape factor of a T section having Flange of width 100mm and thickness 10mm. Web of width 10mm and thickness 90mm. [(CO5) (Evaluate/HOCQ)]
   (b) A two span continuous beam ABC has a span of length AB=6m and BC=6m and carries an uniformly distributed load of 30kN/m. A and C are simply supported.

If the load factors 1.8 and the shape factor is 1.15 for the I-section. Find the section modulus needed. [(CO5)(Evaluate/HOCQ)]

6 + 6 = 12

7. (a) Briefly describe the various steps of **"Plastic Bending of a beam section"** with a neat diagram. [(CO5)(Remember/HOCQ)]

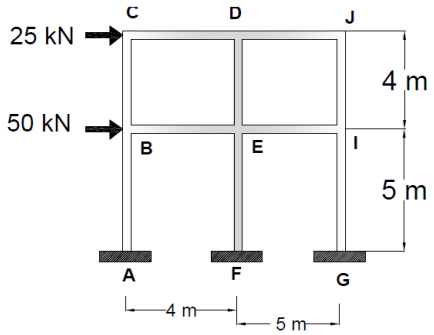
   (b) A continuous beam ABC is loaded as shown in fig. Determine required M_p if the load factor is 3.2. [(CO5)(Evaluate/HOCQ)]



4 + 8 = 12

Group – E

8. (a) Analyse the building frame shown below using Portal Method. Draw separate diagrams to show S.F.D. and B.M.D of columns and beams. [(CO6)(Analyze/IOCQ)]



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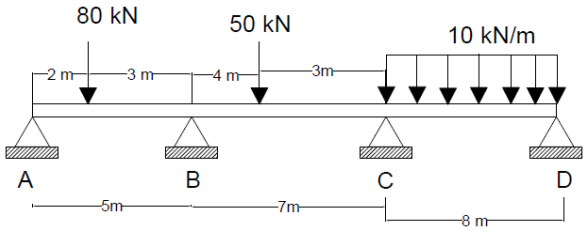
9. Analyse the continuous beam shown below using Flexibility or Stiffness Matrix Method. Also draw the final Bending Moment of this particular beam. [(CO6)(Evaluate/HOCQ)]



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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	8.33 %	16.66	75%

Course Outcome (CO):

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

CO1: Apply the Slope Deflection and Moment Distribution.

CO2: Develop and analyze the concept of suspension bridge and stiffness girders.

CO3: Apply and analyze the concepts of curved beam analysis in hooks, rings and Bow girders.
CO4: Develop the concept bending in unsymmetrical bending in beams.
CO5: Develop the fundamental concepts of plastic analysis using kinematic method and apply them in frames and continuous beam analysis.
CO6: 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

Department & Section	Submission Link
CE & SEC A	https://classroom.google.com/w/NDA1MzAyMjc5NTMy/t/all
CE & SEC B	https://classroom.google.com/w/NDA1MzAyMjc5NTkx/t/all