KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.E.
Year : III

Course : CIEG 308
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 10 FEB 2025

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option from each set of choices

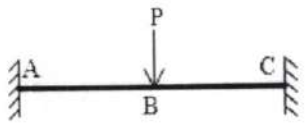
1. Which of the following statement is ***CORRECT***?
   a. Determinate structures are also called as Hyper Static structures.
   b. Analysis of indeterminate structures are possible by imposing the equilibrium conditions of deformations.
   c. In the equilibrium method of analysis, displacement of joints are taken as unknowns.
   d. Statically indeterminate structures generally have lower stiffness than those of comparable determinate structures.

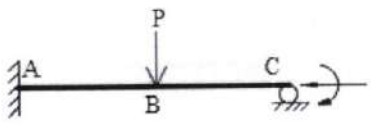
2. For a pin jointed plane frame with 6 no. of joints, 3 nos. of reaction components and 12 nos. of members, the degree of kinematic indeterminacy is given as:
   a. 9 b. 3 c. 15 d. 0

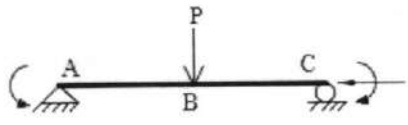
3. Which of the following statement is ***INCORRECT***?
   a. According to Maxwell's reciprocal theorem, for given beam, the deflection at point 'i' due to unit couple at point 'j' is equal to the rotation at point 'j' due to unit load at point 'i'.
   b. Maxwell's theorem is also known as generalized reciprocal theorem.
   c. Castigliano's first theorem gives the value of force at any point.
   d. Castigliano's second theorem gives the value of displacement at any point.

4. According to Castigliano's theorem, deflection at any point on the beam can be obtained as:
   a. $\int_0^L \left(\frac{\partial M}{\partial P}\right)\frac{M}{EI}dx$ b. $\int_0^L \left(\frac{\partial M}{\partial P}\right)\frac{M^2}{EI}dx$ c. $\int_0^L \left(\frac{\partial M}{\partial P}\right)\frac{M}{2EI}dx$ d. $\int_0^L \left(\frac{\partial M}{\partial P}\right)\frac{M^2}{2EI}dx$

5. For a fixed beam *ABC* shown in figure below, the primary beam is:



a.


b.


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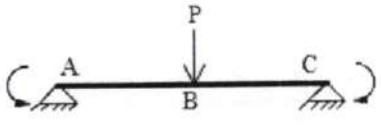
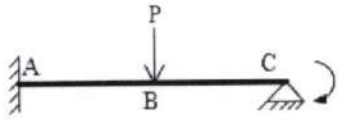


d.


6. For an internally indeterminate truss, the force in member AD is chosen as redundant. The compatibility equation can be written as:

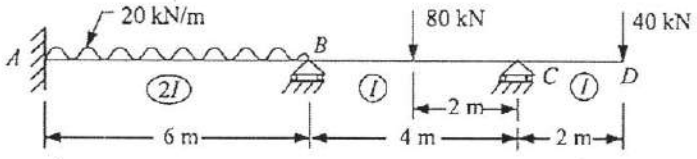
a. $\Delta_{AD0} - F_{AD} f_{AD,AD} = 0$ b. $f_{AD,AD}\Delta_{AD0} + F_{AD} = 0$

c. $\Delta_{AD0} + F_{AD} f_{AD,AD} = 0$ d. $f_{AD,AD} + F_{AD}\Delta_{AD0} = 0$

7. Fixed end moment M_{FAB} for a beam AB of span $2L$ with point load $3P$ applied at mid-span is:

a. $PL/8$ b. $3PL/8$ c. $PL/4$ d. $3PL/4$

8. For a beam $ABCD$ shown in figure below, the slope deflection equation for M_{BA} is:



a. $M_{BA} = -60 + {}^{4}/_{3}\, EI\theta_B$ b. $M_{BA} = 60 + {}^{4}/_{3}\, EI\theta_B$

c. $M_{BA} = 60 + {}^{2}/_{3}\, EI\theta_B$ d. $M_{BA} = 60 + {}^{4}/_{3}\, EI\theta_B + {}^{2}/_{3}\, EI\theta_A$

9. Which of the following statement is ***CORRECT***?

a. In slope-deflection method, settlement Δ is positive if left side support is below right side support.

b. In slope-deflection method, anti-clockwise rotation of a tangent to elastic curve is positive and clockwise rotation is negative.

c. The end moments developed due to the settlement Δ is given as $6EI\Delta/L$.

d. In slope-deflection method, the end moment of any beam is the sum of fixed end moment, moment due to end settlement and moment in simply supported beam due to end rotations.

10. The relative stiffness of a beam with far end fixed is given as:

a. $(4EI)/L$ b. I/L c. $(3EI)/L$ d. $3I/(4L)$

11. Which of the following statement is ***CORRECT***?

a. Moment required to rotate an end by unit angle is termed as carryover factor.

b. Carryover factor for a beam with far end hinged is 0.5.

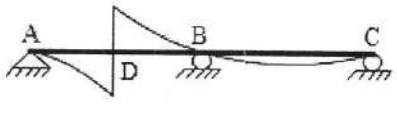
c. Sum of distribution factors for members meeting at a joint is equal to 1.

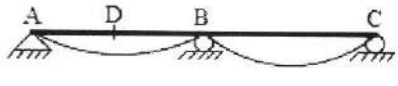
d. Final end moments for a sway frame is the sum of sway moments plus k times non-sway moments, where k is the sway correction factor.

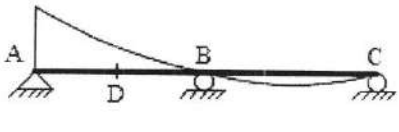
12. A sway frame with columns AB and CD have lengths of 4m and 6m respectively. The end moments M_{AB}, M_{BA}, M_{CD}, M_{DC} are 20, -30, 40 and 10 kNm respectively. The value of sway force is:

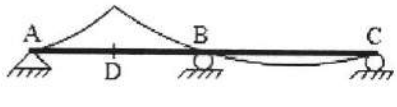
a. 10.83 kN b. -5.83 kN c. -4.17 kN d. 7.5 kN

13. The shape of Influence Line Diagram for Moment at D is:

a.


b.


c.


d.


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14. The plastic section modulus for a rectangular beam of width 300mm and depth 500mm is:
a. 18,750 cm^3 b. 1,250 cm^3 c. 37,500 cm^3 d. 15,300 cm^3

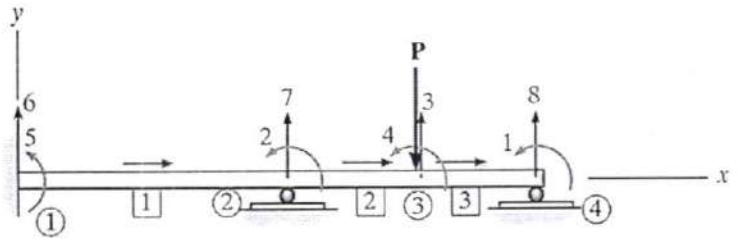
15. Number of plastic hinge for a propped cantilever beam with point load at mid-span is:
a. 0 b. 1 c. 2 d. 3

16. Collapse load for a simply supported beam of span L, carrying point load W at mid-span and having plastic moment capacity $2M_p$ is:
a. $4M_P/L$ b. $8M_P/L$ c. $11.655M_P/L^2$ d. $6M_P/L$

17. An axial member has a length of 2m, cross-sectional area 100 mm^2 and modulus of elasticity 200 kN/mm^2. The element stiffness matrix is:
a. $\begin{bmatrix} 0.1 & -0.1 \\ -0.1 & 0.1 \end{bmatrix}$ b. $\begin{bmatrix} 10 & 10 \\ 10 & 10 \end{bmatrix}$ c. $\begin{bmatrix} 0.1 & -10 \\ -10 & 0.1 \end{bmatrix}$ d. $\begin{bmatrix} 10 & -10 \\ -10 & 10 \end{bmatrix}$

18. The relationship between flexibility and stiffness matrix can be written as:
a. $[\delta] = -[k]$ b. $[\delta]+[k]= 0$ c. $[\delta] = [k]^{-1}$ d. $[\delta] = [k]^2$

19. A continuous beam is shown in figure below with fixed support at *1*, roller at *2* and *4* nodes. The displacement coordinates for each nodes are shown from numbers *1* to *8*. The displacement matrix for the structures is:



a. $[0 \quad 0 \quad 0 \quad 0 \quad \emptyset_5 \quad v_6 \quad v_7 \quad v_8]^T$ b. $[\emptyset_1 \quad \emptyset_2 \quad v_3 \quad \emptyset_4 \quad 0 \quad 0 \quad 0 \quad 0]^T$
c. $[\emptyset_1 \quad \emptyset_2 \quad v_3 \quad \emptyset_4 \quad \emptyset_5 \quad 0 \quad 0 \quad 0]^T$ d. $[0 \quad 0 \quad -P \quad 0 \quad M_5 \quad F_6 \quad F_7 \quad F_8]^T$

20. Which of the following statement is ***CORRECT***?
a. For a beam element, each node have two degrees of freedom, a vertical displacement and a horizontal displacement.
b. The elements lying on leading diagonal of stiffness matrix can also have negative values.
c. In order to generate j^{th} column of flexibility matrix, a unit force should be applied at coordinate 'j' and the displacement at all the coordinates determined.
d. In order to generate j^{th} column of stiffness matrix, a unit displacement should be applied at coordinate 'j' without any displacement at other coordinates and the displacement required at all the coordinates determined.

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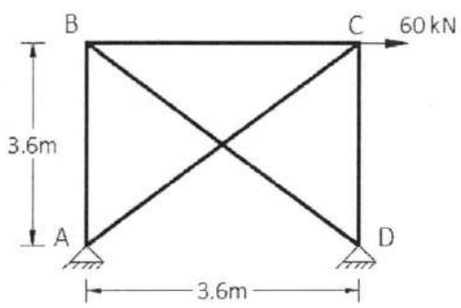
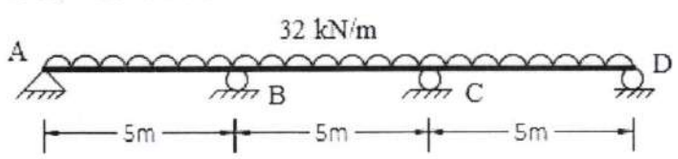
SECTION "B"

Attempt ALL questions. Assume suitable data if necessary.

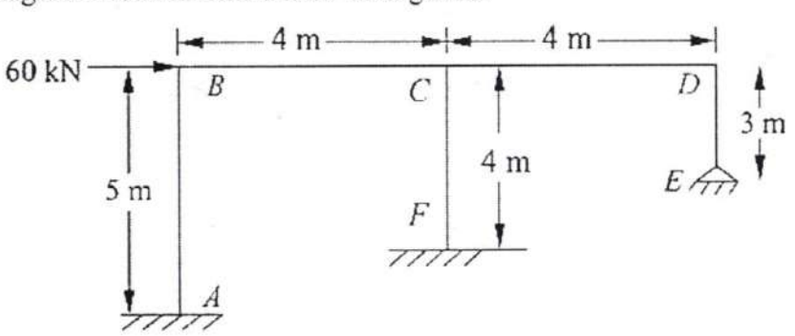
1. Determine the forces in the members of the truss shown in figure by the method of consistent deformations. *AE* is constant for all the members. [6]



2. Draw the bending moment and shear force diagram for the three-span continuous beam shown in Figure due to the uniformly distributed load and due to the support settlements of 15 mm at *B*, 36mm at *C*, and 18 mm at *D*. Use the slope-deflection method. Take E= 200 GPa and I=1705 × 10^6 mm^4. [7]



3. Analyze the frame shown in figure by moment distribution method and draw the bending moment diagram. Assume constant *EI* throughout. [7]



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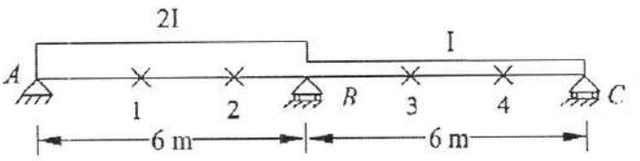
4. Draw the influence line diagram for bending moment at point *2* in the continuous beam shown in figure below at 2m interval using Muller-Breslau Principle. [6]



5. What is mechanism? Explain briefly various types of mechanism. Show that the shape factor of a circular section is 1.698. [1+3+3]

6. How is the stiffness matrix method used in the analysis of structure? Determine the stiffness matrix of the pin-jointed frame shown in figure below. [2+5]