KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Level : B.Arch.
Year : III
Time : 2 hrs. 30 mins.

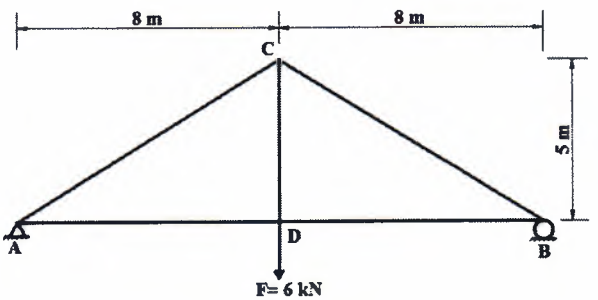
08 FEB 2024

Course : CIEG 331
Semester : I
F.M. : 40

SECTION "B"

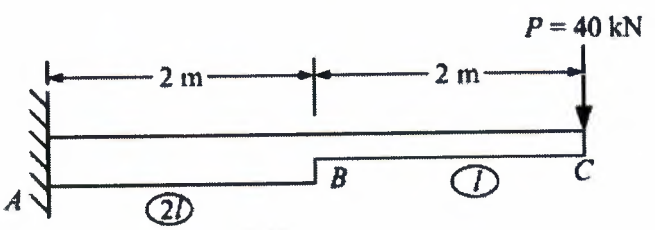
Attempt *ALL* questions. Assume any necessary data.

1. Define the term statically indeterminate structures with an example. Determine the forces in each member of the truss given below. State if the members are in tension and compression. Assume all members are pin jointed. [2+4]

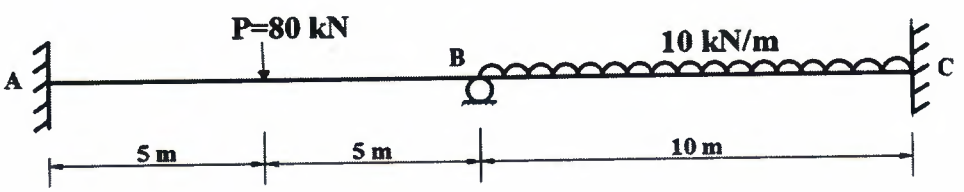


2. Define the virtual work method and its application to analyze the structure. A steel specimen 1.5 cm^2 in cross-section stretches 0.05 mm over a 5 cm gauge length under an axial load of 30 kN. Calculate the strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is 50 kN, Calculate the elongation of the elastic limit. [3+4]

3. Define the Moment Distribution Method to analyze the statically indeterminate structure. Using strain energy method, determine the vertical displacement at free end of the cantilever beam shown in figure below. Given E= 200 kN/mm^2 and I= 20 $\times 10^6$ mm^4. [3+5]



4. Define the Strain Energy due to axial force and its application. Determine the reactions and draw the shear and bending moments diagrams for the two- span continuous beam as shown the figure below by using the Slope-Deflection Method. Take EI= constant. [3+7]



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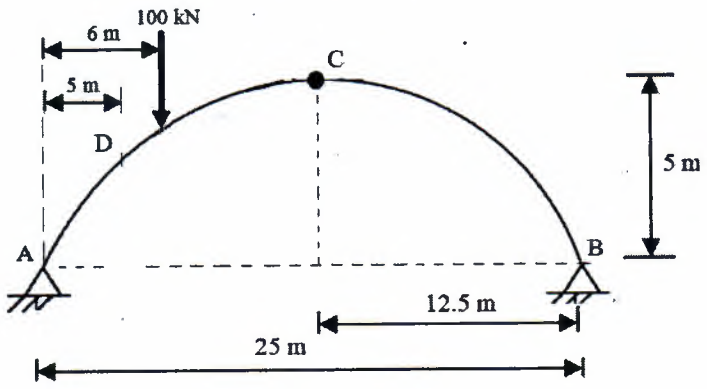
5. Define the influence line diagram and its application. A circular arch to span 25m with a central rise of 5m is hinged at the crown and springing, as shown below figure. It carries a point load of 100 kN at 6m from the left support. Calculate the reactions at supports, reaction at the crown and bending moment at 5m from the left support. [3+6]



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Marks Scored:

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Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

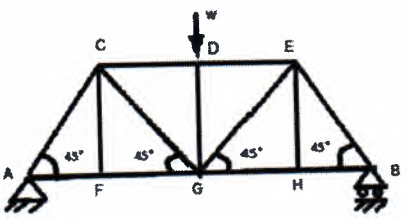
SECTION "A"

[20Q. × 0.5 = 10 marks]

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

1. The degree of static indeterminacy of a rigid pointed plane frame having 15 members, 3 reaction components and 14 joints are
   a. 2 b. 3 c. 6 d. 8

2. Determine the value of force in member G of the truss given as show in figure.
   a. 0
   b. W
   c. W/2
   d. W/√2



3. If a system is in equilibrium and the position of the system depends upon many independent variables, the principal of the virtual states that the partial derivatives of its total potential energy with respect to each of the independent variable must be
   a. -1.0 b. 0 c. 1.0 d. ∞

4. The area-moment theorem with respect to bending of beam states that the area of the M/EI diagram between two sections of a beam gives
   a. the difference in the maximum bending strains between those two sections
   b. the difference in slopes between those two sections
   c. the difference in deflections between those sections
   d. the difference in strain energies between those two sections

5. The ratio of the stresses produced by a suddenly applied load to a gradually applied load on a bar is
   a. 1/4 b. 1/2 c. 1 d. 2

6. A cantilever beam of length L is subjected to a bending moment at its free end. If EI is the flexural rigidity of the section, the deflection of the free end, is
   a. ML/EI b. ML/2EI c. $ML^2/2EI$ d. $ML^2/3EI$

7. The strain energy stored in a spring when subjected to greatest load without being permanently distorted, is called
   a. Stiffness b. Proof resilience c. Proof stress d. Proof load

8. Betti's Theorem is based on _____
   a. balancing of external and internal forces
   b. balancing of work done produced by external and internal loadings
   c. balancing of external and internal moments
   d. balancing of strain energy produced by external and internal loadings

9. The ratio of maximum shear stress to average shear stress of a circular beam, is
   a. 4/3 b. 2/3 c. 3/2 d. 3/4

10. If a section divides the span of a simply supported beam as c and (l - c), the ordinate of influence line diagram, for BM at the section will be
   a. maximum at the section and equal to c(l - c)
   b. maximum at the section and equal to c(l - c)/l
   c. maximum at the section and equal to l(l - c)/c
   d. maximum at the supports and equal to unit

11. The ordinates of the influence line for the left support reaction of a simply supported beam with an overhang on the left are 1.0 and 1.2 at the left support point and the free end respectively. The distance between the two supports is 5m. Find the length of the overhang portion.
   a. 0.2 m b. 1 m c. 1.2 m d. 6.0 m

12. In a simply supported beam of span 10m, a UDL of 10 kN/m of length 5m is moving from left to right support. The maximum bending moment at 4 m from the left support is
   a. 70 kN-m b. 50 kN-m c. 90 kN-m d. 50 kN-m

13. For a single point load W moving on a symmetrical three hinged parabolic arch of span L, the maximum sagging moments occurs at a distance x from the ends. The value of x is_____?
   a. 0.211 L b. 0.25 L c. 0.234 L d. 0.5 L

14. The maximum B.M. due to an isolated load in a three-hinged parabolic arch, (span l, rise h) having one of its hinges at the crown, occurs on either side of the crown at a distance
   a. l/4 b. $\frac{l}{3\sqrt{2}}$ c. h/4 d. $\frac{l}{2\sqrt{3}}$

15. The internal shear force generated in a three hinged arch is always:
   a. 0 b. ∞
   c. Varies d. Non zero but the value remains constant

16. The stiffness factor for a prismatic beam of length L and moment of inertia I is
   a. E/L b. 2E/L c. 3E/L d. 4E/L

17. Carryover moment is defined as _____.
   a. The moment applied at one end to cause unit slope at the support
   b. The additional moment applied at one end to completely resist the rotation caused due to external loading
   c. The moment developed or induced at one end due to a moment at another end
   d. The moment applied at one end to cause unit slope at another end

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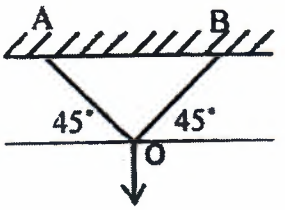
18. The maximum deflection in a cantilever beam with UDL 'w' over the entire length 'L' is
    a. at the free end and equals to $wL^4/4EI$
    b. at the free end and equals to $wL^4/8EI$
    c. at the fixed end and equals to $wL^4/4EI$
    d. at the fixed end and equals to $wL^4/8EI$

19. Two bars AO and BO are of uniform area A and length l are hinged at O as shown in figure. A load w is applied at o. The vertical deflection of o will be:



    a. $Wl/2AE$
    b. Wl/AE
    c. W^2l/AE
    d. $W^2l/2AE$

20. The deflection at any point of a perfect frame can be obtained by applying a unit load at the joint in
    a. vertical direction
    b. horizontal direction
    c. the direction in which the deflection is required
    d. inclined direction