STRUCTURAL ANALYSIS – I
(CIV2201)

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) A rigid-jointed plane frame is stable and statically determinate if
(a) (m+r) =2j (b) (m+r) =3j
(c) (3m+r) =3j (d) (m+3r) =3j

(ii) Castigliano's theorem for deflection i.e. $\frac{\partial u}{\partial P} = \delta$ (deflection) is true for
(a) Linearly elastic structure (b) Rigid structure
(c) Non-linearly elastic structure (d) Any structure

(iii) A three hinged arch of span "l" and rise "h", an udl of "w" acts per unit length over the entire span, the horizontal reaction at each support is given by
(a) $wl^2/8h$ (b) $wl^2/10h$ (c) $wl^2/4h$ (d) $wl^2/6h$

(iv) The influence line for bending moment in a simply supported beam is
(a) A straight line
(b) A triangular shape
(c) A piecewise linear function with a peak at the considered point
(d) A circular arc

(v) The maximum bending moment at a point in a simply supported beam due to a moving load occurs when
(a) The load is placed at the support
(b) The load is placed at the section under consideration
(c) The load is at the midpoint of the beam
(d) The load is at the farthest end from the section

(vi) The Muller-Breslau principle states that the shape of an influence line for a function in a beam can be obtained by
(a) Applying a unit load at the required location
(b) Removing the constraint corresponding to that function and applying a unit displacement
(c) Drawing a moment diagram due to a unit load
(d) Integrating the load distribution

(vii) In the **Theorem of Three Moments**, the number of equations required for the analysis of a three-span continuous beam is:
(a) 1 (b) 2 (c) 3 (d) 4

(viii) For a two hinged arch, if one of the supports settles down vertically, the horizontal thrust
(a) Increased (b) Decreased (c) Remains unchanged (d) Becomes Zero

(ix) Which method is commonly used to determine influence lines for statically indeterminate beams?
(a) Method of joints (b) Conjugate beam method
(c) Müller-Breslau principle (d) Graphical method

(x) For a propped cantilever beam, the influence line for vertical reaction at the fixed support is
(a) A straight line (b) A cubic curve
(c) A parabolic curve (d) A discontinuous function

Fill in the blanks with the correct word

(xi) The deflection at the free end of a cantilever beam carrying a concentrated load (P) _____.

(xii) The Theorem of Three Moments expresses the condition of _____.

(xiii) The strain energy of a structure due to bending is given by_____.

(xiv) Bending moment at any section in a conjugate beam gives in the actual beam as _____.

(xv) For a uniformly distributed moving load, the maximum bending moment occurs when the load is placed _____ over the beam.

Group - B

2. A three hinged arch as shown in Fig. 1 consists of two quadrantal parts AC and CB of radii 3m and 5m respectively. For the load system acting on the arch, calculate the reactions at the supports and the bending moments under the loads. *[(CIV 2201.2,CIV 2201.3)(Analyse/IOCQ)]*

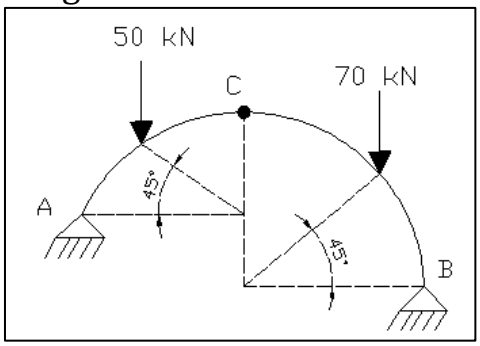

Fig. 1

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3. Determine the horizontal displacement at roller support in the frame as shown in Fig. 2. Flexural rigidity EI is constant throughout. *[(CIV2201.6)(Evaluate/HOCQ)]*

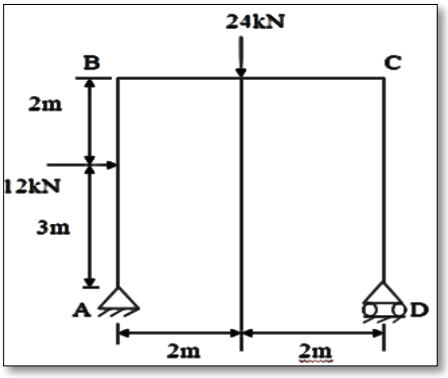

Fig.2

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Group - C

4. Prepare the ILD for reaction forces, shear force and bending moment at section C as shown in Fig. 3. Evaluate the maximum value of shear and bending moment that can develop at section C under a uniformly moving load of 20kN/m moving from left end to right end having a length of 3m. Assume suitable data if not provided. *[(CIV2201.6)(Analyse/IOCQ)]*

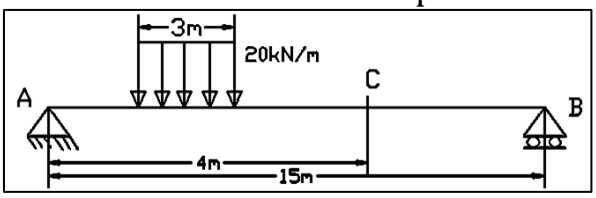

Fig. 3

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5. Construct the influence line diagram for the force in members BC, BG and HG of the truss shown in Fig. 4. *[(CIV2201.6)(Analyse/IOCQ)]*

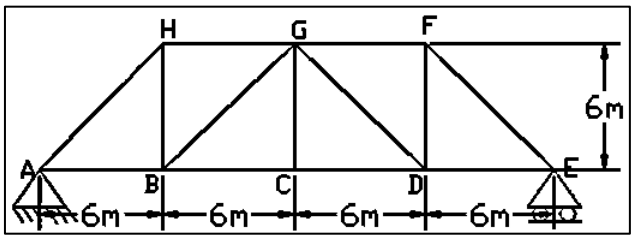

Fig. 4

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Group - D

6. (a) Find out the expression for horizontal reaction of the two-hinged parabolic arch under the given loading as shown in Fig. 5. *[(CIV2201.2, CIV2201.3)(Analyse/IOCQ)]*

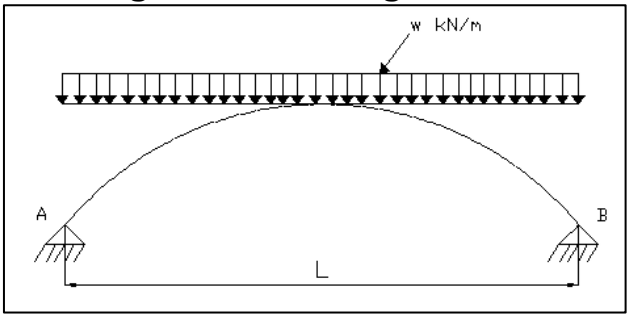

Fig. 5

(b) If the value of udl is 5 kN/m, central rise 4m and span of 30m for the above two hinged parabolic arch in Fig. 5, then find out the horizontal thrust on the arch. Also find out the bending moment at the crown. *[(CIV2201.2, CIV2201.3)(Analyse/IOCQ)]*

7 + 5 = 12

7. A continuous beam ABC as shown in Fig. 6 covers two consecutive spans AB and BC of lengths 4m and 6m carrying uniformly distributed loads of 60kN/m and 100kN/m respectively. If the ends A and C are simply supported find the support moments at A, B and C. Draw also B.M and S.F. diagram. *[(CIV2201.5)(Analyse/HOCQ)]*

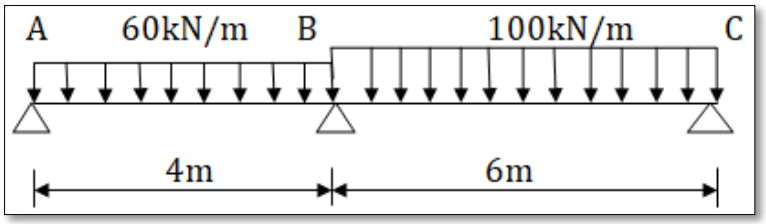

Fig. 6

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Group - E

8. Compute the ordinates of influence lines for reaction at A for the beam shown in Fig. 7 at 1m interval and draw the influence line diagram. The moment of inertia is as shown in figure. *[(CIV2201.6)(Analyse/IOCQ)]*

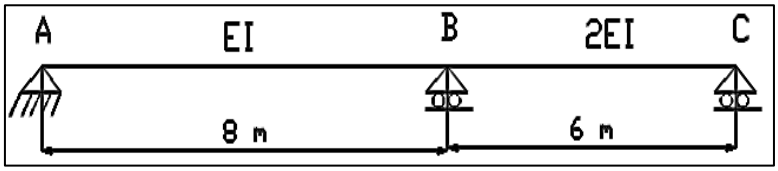

Fig. 7

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9. Draw the influence line diagram for shear force at D in the beam shown in Fig. 8 after computing the values of the ordinates at 1m interval. Flexural rigidity is constant throughout. *[(CIV2201.6)(Analyse/IOCQ)]*

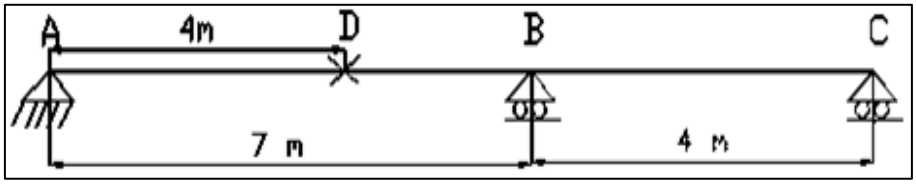

Fig. 8

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	0	75	25