(vi) A parabolic two hinged arch subjected to uniformly distributed loading per unit horizontal length over the entire span has
(a) zero B.M. at all sections
(b) maximum normal thrust at the crown
(c) has varying radial shear over its length
(d) a parabolic variation of BM over the span.

(vii) When a load is applied to a structure with rigid joints
(a) there is no rotation or displacement of joint
(b) there is no rotation of the joint
(c) there is no displacement of joint
(d) there can be rotation and displacement of joint but the angle between the members connected to the joint remains same even after application of the load.

(viii) The expression given by Castiglianos first theorem to determine the deflection component of any point on structure is

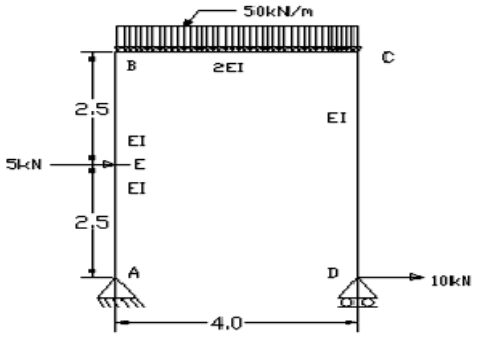
(a) $\int \frac{M}{EI}\frac{\partial M}{\partial P}$ (b) $\int \frac{\partial M}{\partial P}\frac{dx}{EI}$ (c) $\int M\frac{\partial M}{\partial P}\frac{dx}{EI}$ (d) $\int \frac{M}{P}\frac{\partial x}{\partial EI}$

(ix) Clapeyron's theorem expresses the condition of
(a) equilibrium of forces (b) slope compatibility
(c) maxwell's reciprocal theorem (d) superposition of forces.

(x) The method of virtual work in the analysis of structures results in
(a) compatable deformations (b) equilibrium of forces
(c) stress strain relations (d) consistent force.

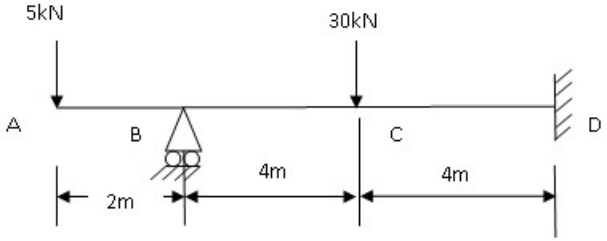
Group – B

2. Determine the horizontal deflection and rotation at the end D of the portal frame shown below. Given, E = 2 × 10^5 N/mm² & I = 12 × 10^6 mm⁴. Dimensions are in meters unless otherwise specified.

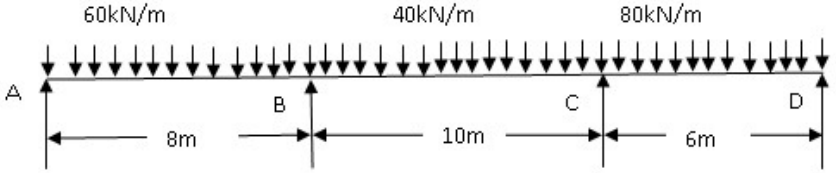


12

7. (a) Calculate the reactions if the structure is loaded as shown. I = 150 × 10^{-6} m⁴, E = 200GPa.



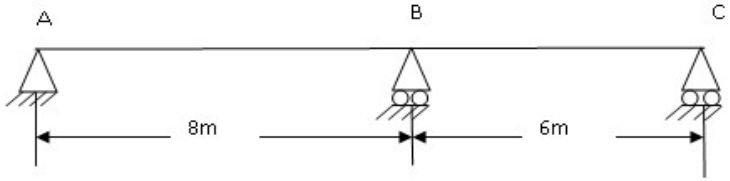
(b) Analyze the continuous beam shown in fig. using the three moment equation. Determine the bending moments and reaction at the supports. EI is constant throughout.



6 + 6 = 12

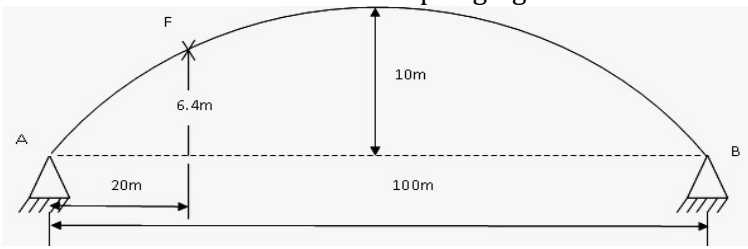
Group – E

8. Compute the ordinates of influence lines for reactions R_B for the beam shown in Fig. at 1m interval and draw the influence line diagram. Assume flexural rigidity EI is constant throughout.



12

9. A two hinged parabolic arch is of span 100m and rise 10m. Draw the influence line diagrams for horizontal reaction, bending moment and shear force at section F 20m from the left hand springing.



12

ANALYSIS OF STRUCTURES - I
(CIVL 2201)

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.

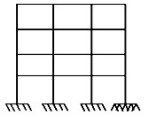
Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

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

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

(ii) Find out the degree of static indeterminacy of the following 2D frame.

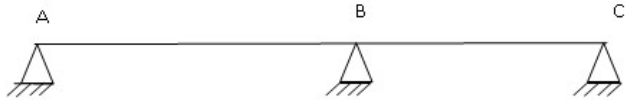


(a) 57 (b) 42 (c) 36 (d) 68.

(iii) A simply supported beam of flexural rigidity 'EI' and span l, carries an udl of value w kN/m throughout its span. The expression for deflection of the beam, at the midpoint will be
(a) $5wl^4/584EI$ (b) $5wl^4/384EI$
(c) $wl^3/3EI$ (d) $wl^3/48EI$.

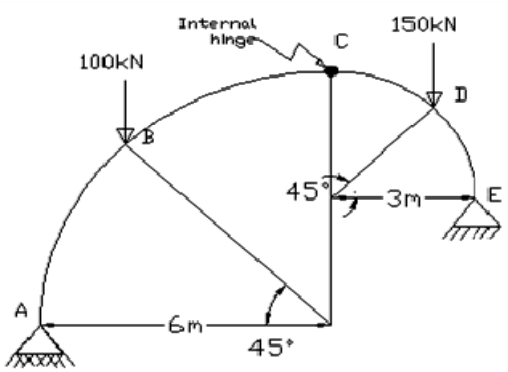
(iv) When a point load moves from left to right over a girder, then the maximum bending moment occurs at the mid span when the position of the load is
(a) over the left support (b) at 1/3rd point from left end
(c) exactly at the middle point (d) over the right support.

(v) What is the degree of kinematic indeterminacy of the beam shown below, if the axial deformation is ignored?

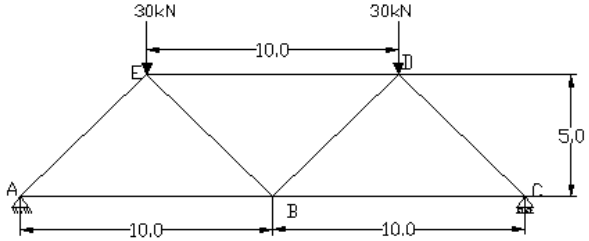


(a) 2 (b) 3 (c) 4 (d) 5.

3. (a) A three hinged arch consists of two quadrantal parts AC and CE of radii 6m and 3m respectively. For the load system acting on the arch, calculate the reactions at the supports and the bending moments under the loads.



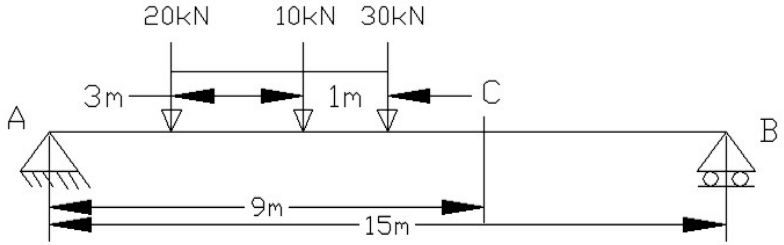
(b) The pin jointed truss shown below is carrying point loads of magnitude 30kN at points E and D. Find out the horizontal and vertical deflection of joint E by unit load method. All dimensions are in meters, unless otherwise specified.



4 + 8 = 12

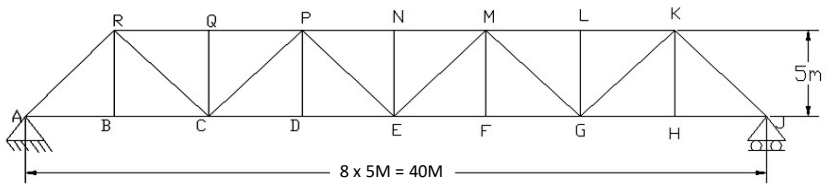
Group – C

4. Prepare the ILD for reaction forces, shear forces and bending moments at section C. Evaluate the maximum value of positive shear and bending moment that can develop at section C under the given series of loading.



12

5.

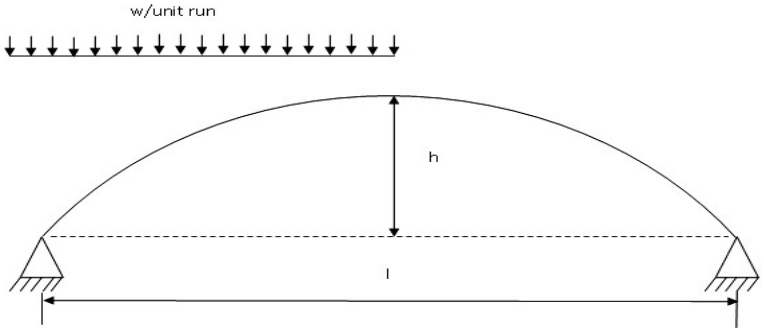


Construct the influence line diagram for the forces in member BC, BR and CP of the truss shown above.

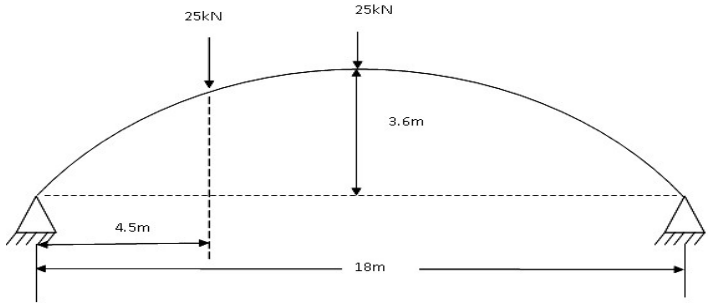
12

Group – D

6. (a) A two hinged parabolic arch of span l and rise h carries a uniformly distributed load of w per unit run on the left half of the span. Find the horizontal thrust. Assume secant variation of moment of inertia of the arch section.



(b) A two hinged parabolic arch of span 18m and rise 3.6m carries two concentrated loads of 25kN each at the crown and at the left quarter span section. Find the horizontal thrust at each support and the bending moments at the loaded sections. Assume secant variation of moment of inertia of the arch section.



6 + 6 = 12