Roll No:

NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR (H.P)

End Semester Examination for B.Arch (Architecture), III- Semester (II nd Year): 2023 – 2024

Branch: Architecture **Semester:** III

Course Name: Analysis of Structures **Course Code:** CE 218

Duration: 3 Hours, (09.30 A.M -12.30 P.M), A **Mark. Max:** 50

Date: 22.11.2023(Wed day)

Instructions:

a) Answer any of **FOUR Questions Only**

b) All dimensions (Distance and force Units) are in " m & kN " except when specified otherwise (S.I Units)

c) Assume necessary data wherever required.

d) **Table 1** Fixed **End Moment** is enclosed here on the last page.

(Q.1) Construct the **Shear force, Axial force (Horizontal Thrust) diagrams, and Bending Moment Diagrams** for the following loaded **simply supported beam structures** as shown in Fig.1.

12.5 Marks

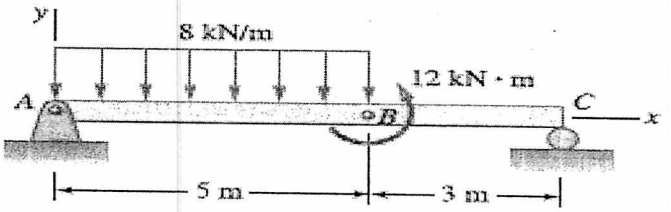


Fig.1

(Q.2) (a) Compute the **Maximum and Minimum Bending Stress** and its corresponding **location** in the beam as shown in Fig.2. (b) Draw the **Bending Stress Distribution** over the cross-section at this location.

12.5 Marks

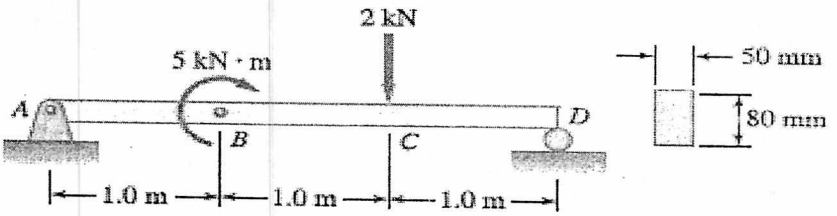


Fig.2

(Q.3) Four gears are attached to a circular shaft and transmit the torques shown in Fig.3. The allowable shear stress in the shaft is 70MPa. (a) What is the required **diameter *d* of the shaft** if it has a **solid cross-section**? (b) What is the required **outside diameter *d* if the shaft is hollow with an inside diameter of 40mm**?

12.5 Marks

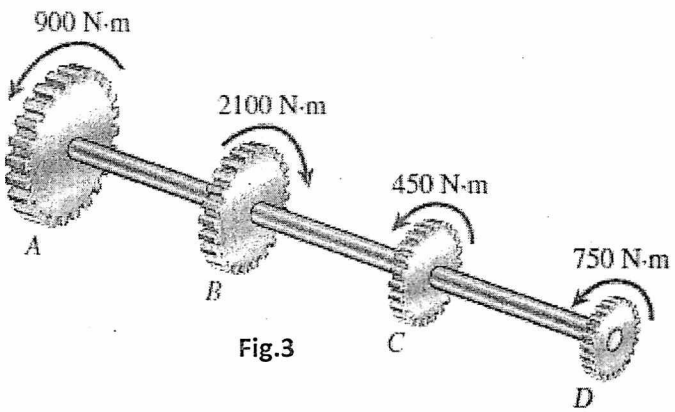


Fig.3

(Q.4) A truss having the length of each member is 4 m as shown in Fig.4. (a) Compute the **Internal force of all component members of the truss** Using **(i) Method of Joints.** (b) Compute the **Internal force of the BE** component member of the truss using **(ii) Method of Section.** **12.5 Marks**

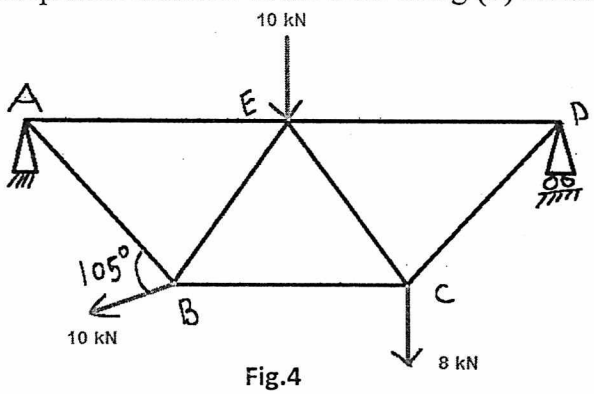


Fig.4

(Q.5) Analysis of a **three-hinged Parabolic arch** of span 20 m and rise 3 m carries a point load of 10 kN at a 7.5 m horizontal length on the left side of the arch and uniformly distributed load of 2 kN/m covers the right half of horizontal length on the arch as shown in Fig.5. Calculate (a) **Support reaction, the direction and magnitude of resultant reactions** at the springing, (b) the position and amount of **maximum bending moment (Maximum positive and negative bending moments),** also draw **bending moment diagram** of arch and (c) the **Normal thrust, Bending moment and Radial shear** at a section 7.5m from the left support. **12.5 Marks**

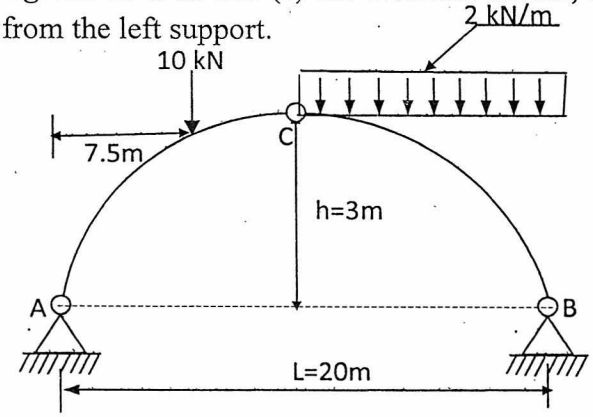


Fig.5

(Q.6) A loaded cord ACDEB spans 40 m as shown in Fig.6. The dip of the cord at D is 13 m below the left support A. The left support A and right support B are the same level. Find (a) the **Reactions** at the supports, (b) the **Tensions** in the various parts of the cable, (c) the **inclinations** of the various parts of the cable (Direction of Tension force), (d) the **sag (or) dip** at E, C. (e) the **total length** of the cable and (f) Required **cable cross-sectional area** if the safe tensile stress is 140 N/mm^2.

12.5 Marks

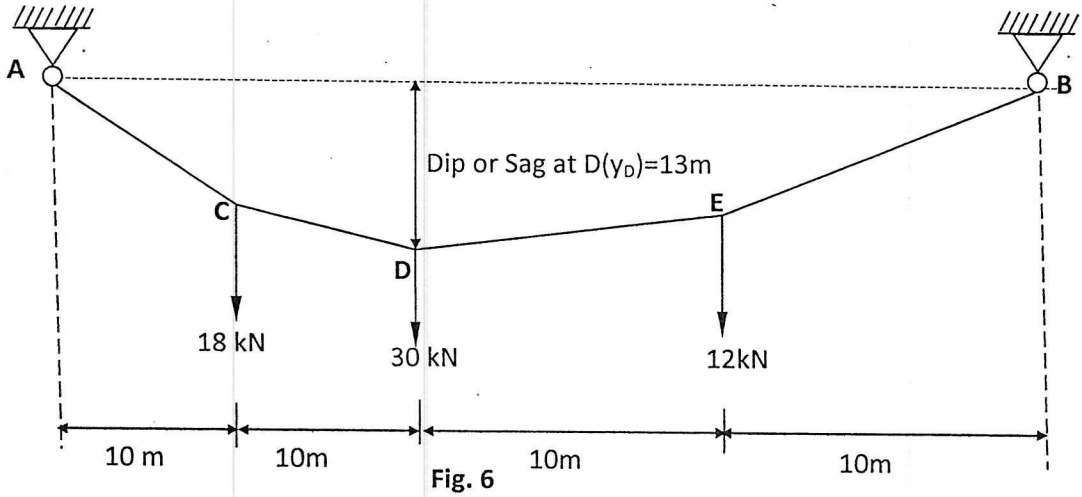


Fig. 6

(Q.7) Analyze the rigid jointed portal frame shown in Fig.7 by following **approximate methods for (a) Vertical gravity load only using the substitute frame method and (b) Lateral wind load using the Cantilever Method.** Draw the Axial Trust, shear force, and bending moment diagram. The cross-sectional areas of exterior columns and interior columns are all assumed to be 2A &A.

12.5 Marks

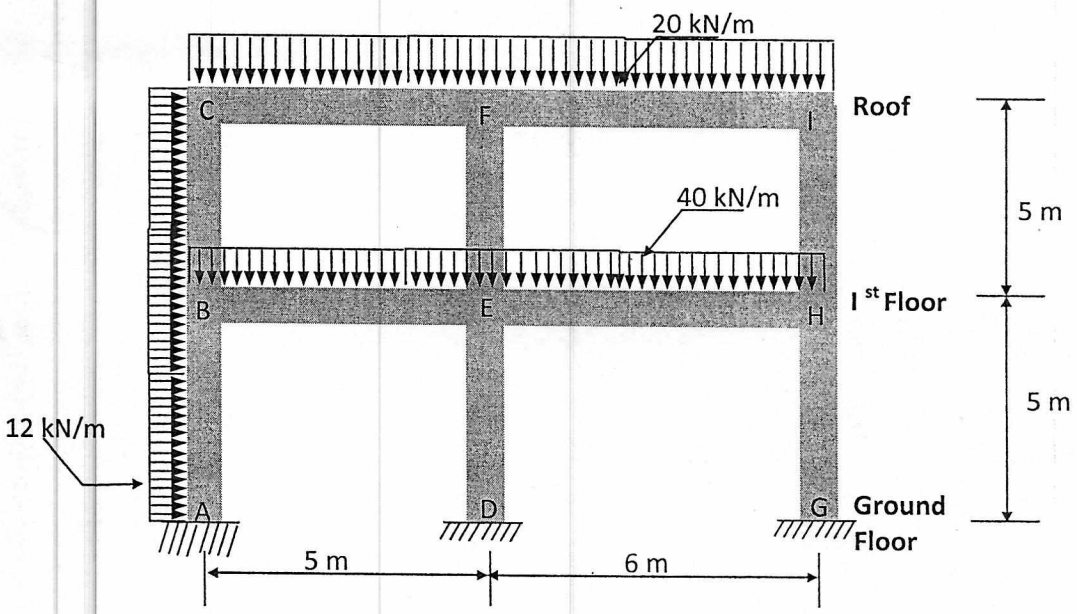


Fig. 7

(Q.8). Analyze the continuous beam shown in Fig.8 **by Claypeyron's Theorem of Three-moment Equations** for downward settlements of 20 mm at B and 30mm at C. Take $I=5x10^9$ mm^4 and $E=200$ kN/mm^2. Draw the elastic curve, shear force, and bending moment diagram. **12.5 Marks**

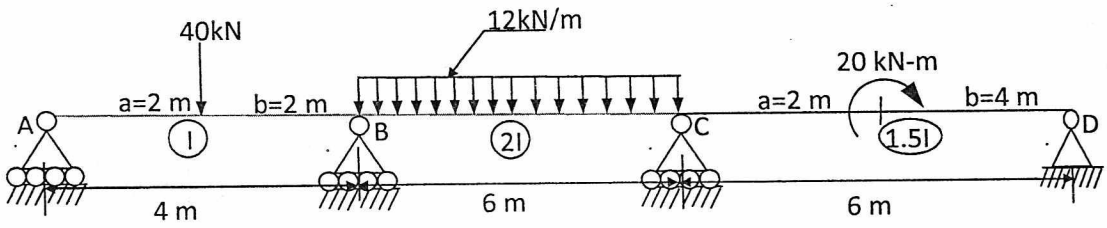


Fig. 8

(Q.9) Analyze the continuous beam as shown in Fig.9 **by the Moment Distribution Method.** The support C sinks (or) settles down 20mm and the support D sinks (or) settles down 10mm. Take $I=5x10^9$ mm^4 and $E=200$ kN/mm^2. Draw the elastic curve, shear force, and bending moment diagram. **12.5 Marks**

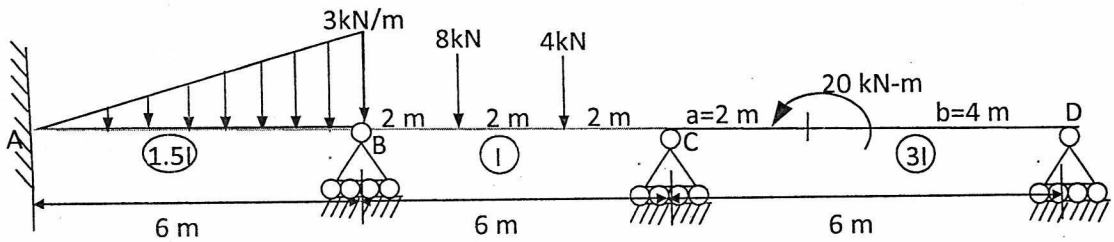
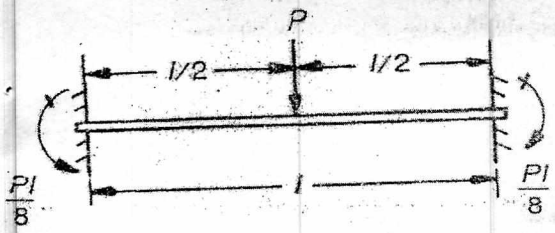


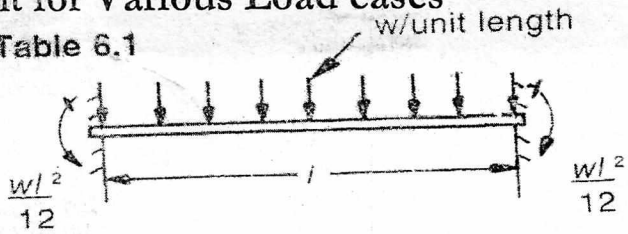
Fig. 9

Table 1 Fixed End Moment for Various Load cases

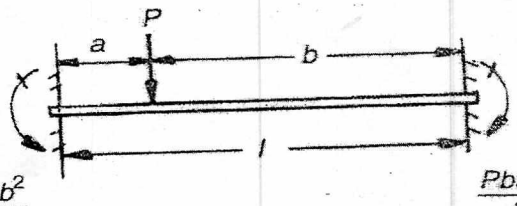
Table 6.1



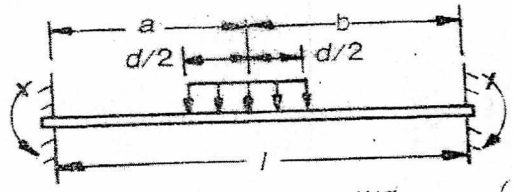
$\frac{Pl}{8}$ $\frac{Pl}{8}$



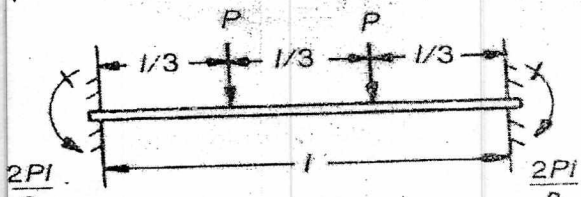
$\frac{wl^2}{12}$ $\frac{wl^2}{12}$



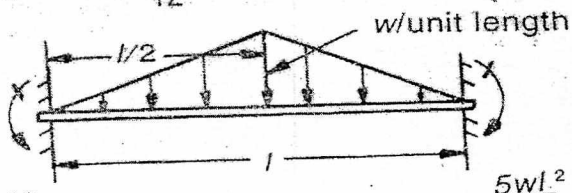
$\frac{Pab^2}{l^2}$ $\frac{Pba^2}{l^2}$



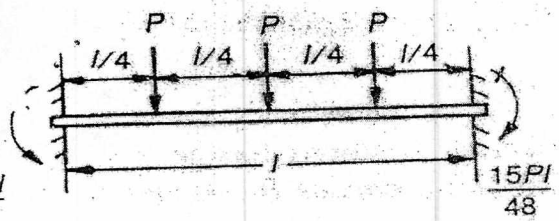
$\frac{wd}{l^2}(ab^2 + \frac{(a-2b)}{12}d^2)$ $\frac{wd}{l^2}(ba^2 + \left(\frac{b-2a}{12}\right)d^2$



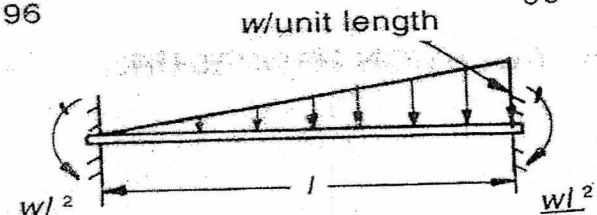
$\frac{2Pl}{9}$ $\frac{2Pl}{9}$



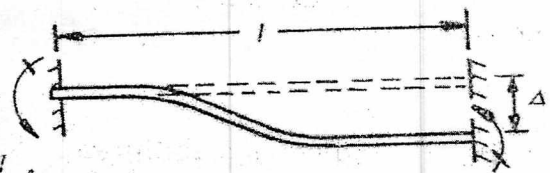
$\frac{5wl^2}{96}$ $\frac{5wl^2}{96}$



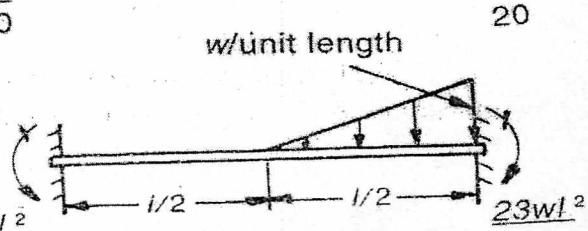
$\frac{15Pl}{48}$ $\frac{15Pl}{48}$



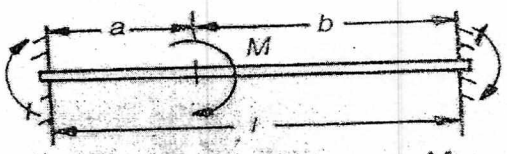
$\frac{wl^2}{30}$ $\frac{wl^2}{20}$



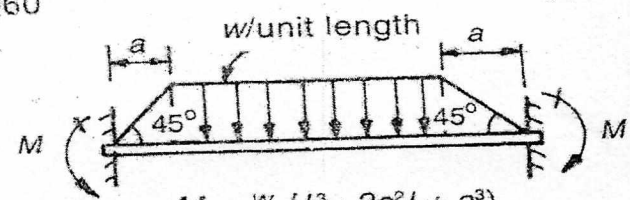
$\frac{6EI}{l^2}\Delta$ $\frac{6EI}{l^2}\Delta$



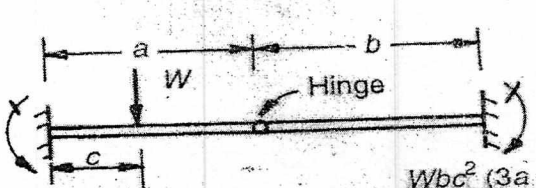
$\frac{7wl^2}{960}$ $\frac{23wl^2}{960}$



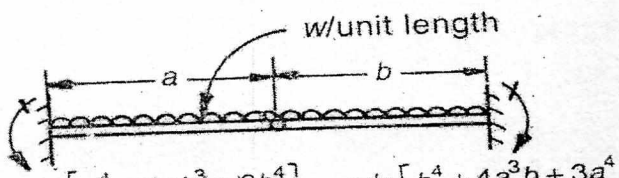
$\frac{Mb}{l^2}(2a-b)$ $\frac{Ma}{l^2}(2b-a)$



$M = \frac{w}{12L}(l^3 - 2a^2l + a^3)$



$\frac{Wc(2a^3 - 3a^2c + ac^2 + 2b^3)}{2(a^3+b^3)}$ $\frac{Wbc^2(3a-c)}{2(a^3+b^3)}$



$\frac{wa}{8}\left[\frac{a^4 + 4ab^3 + 3b^4}{a^3+b^3}\right]$ $\frac{wb}{8}\left[\frac{b^4 + 4a^3b + 3a^4}{a^3+b^3}\right]$