

(3 Hours)

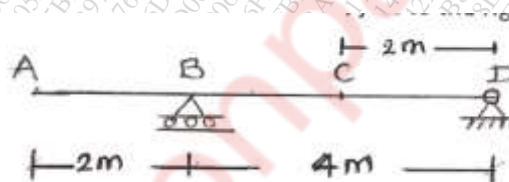
Maximum Marks-80

NB:

- 1 Q. No. 1 is compulsory. Attempt any three out of remaining five questions.
- 2 Figures to the right indicate full marks.
- 3 Assume suitable data if necessary but justify the same.
- 4 Draw neat sketches wherever necessary.

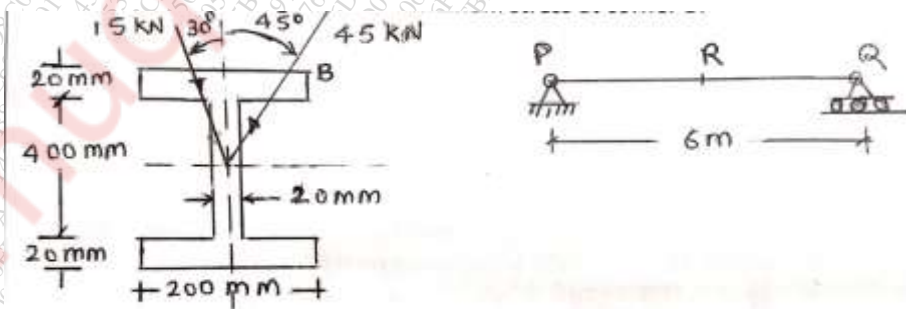
Q.1 Attempt any four questions.

- (a) Write Moment Area Theorems - I & II, giving neat sketches. 5
- (b) Differentiate between symmetrical & Unsymmetrical bending, giving suitable examples. 5
- (c) State and explain-(i) Maxwell's theorem (ii) Betti's theorem 5
- (d) Define the term 'Strain Energy' and state its expression for (i) Axial force (ii) Bending moment (iii) Shear force and (iv) Torsion 5
- (e) Explain the necessity & function of stiffening girder in a Cable-Suspension bridge. 5
- (f) For the beam shown in figure draw the qualitative influence line diagram (ILD) for (i) BM at C (ii) SF at section taken, just to the right of support B. 5



Q.2 (a) A simply supported beam of span PQ = 6 m is subjected two point loads 15 KN and 45 KN applied at mid span point R through two different planes as shown in I-section of the beam. Find- 10

- (i) Resultant plane of loading
- (ii) Location of neutral axis.
- (iii) Nature and magnitude of maximum stress at corner B.

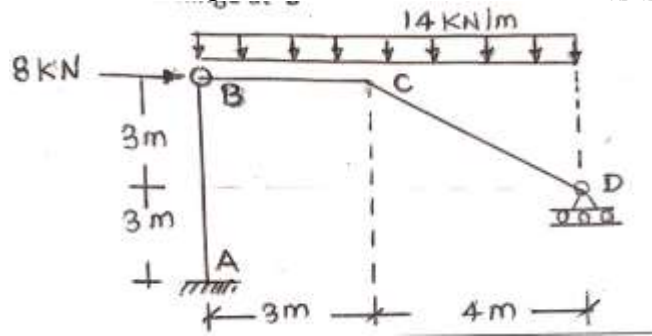


Q.2 (b) For the rigid jointed plane frame ABCD loaded as shown in figure- 10

- (i) Find support reactions.
- (ii) Draw Free body diagram (FBD) of all members.

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(iii) AFD, SFD and BMD for the frame indicating salient points.
 Note that there is internal hinge at 'B'

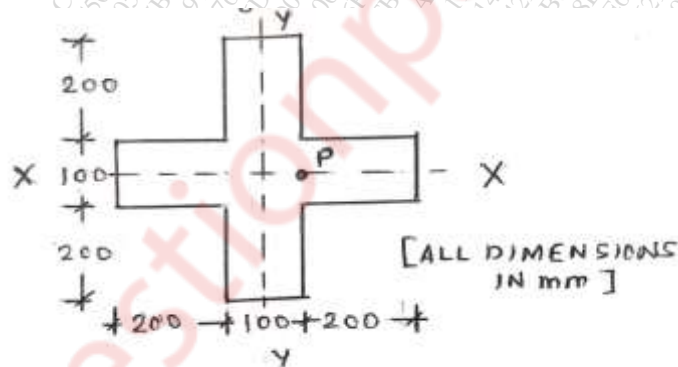


Q.3 (a) A 3-hinged symmetrical **circular arch** of span 30 m and central rise 6 m is subjected UDL of 12 KN/m over the entire span. Determine- **10**

- (i) Support reactions.
- (ii) BM, NT and RSF at left quarter span point

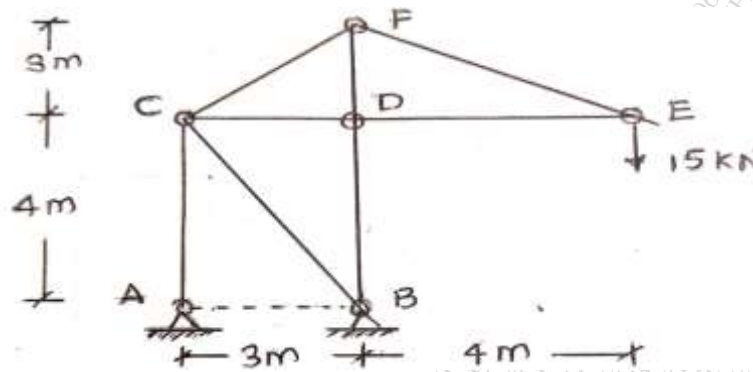
Also draw BMD for the arch clearly indicating the location & magnitude of maximum bending moment.

(b) Figure shows the **plus** cross section (symmetrical) of a column which is 8 m long with both ends hinged. This column is subjected to a load of $P = 600$ KN applied at an eccentricity of 50 mm from the axis of column. Determine the extreme fibre stresses if $E = 150$ GPa for column material. Also sketch the stress distribution diagram. **10**

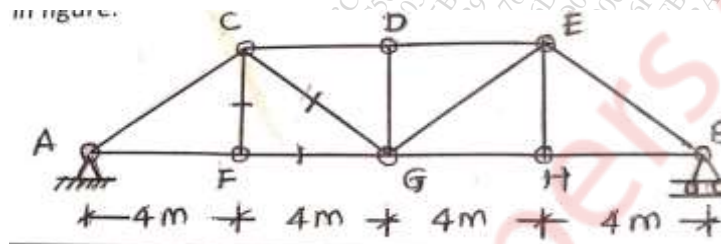


Q.4 (a) A non-prismatic cantilever beam ABC fixed at 'A' with $AB = BC = 3$ m is having flexural rigidity $2EI$ & EI respectively. It is subjected to UVL having zero intensity at B and maximum 12 KN/m at C. Using **Moment Area Method** or **Conjugate Beam Method**, determine slope at 'B' and deflection at free end 'C' in terms of EI . **10**

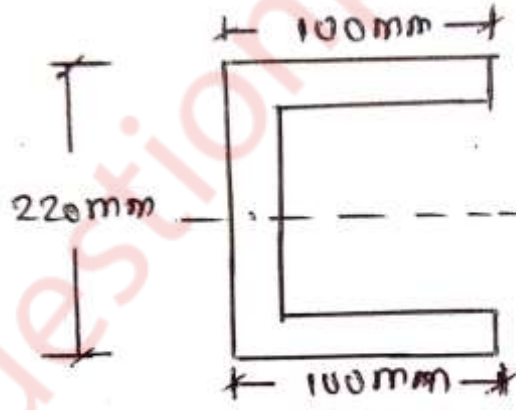
Q.4 (b) A pin-jointed frame loaded and supported as shown in figure. Determine horizontal deflection of joint 'E'. Take $AE =$ constant for all the members. Use **unit load method** or any other suitable method. **10**



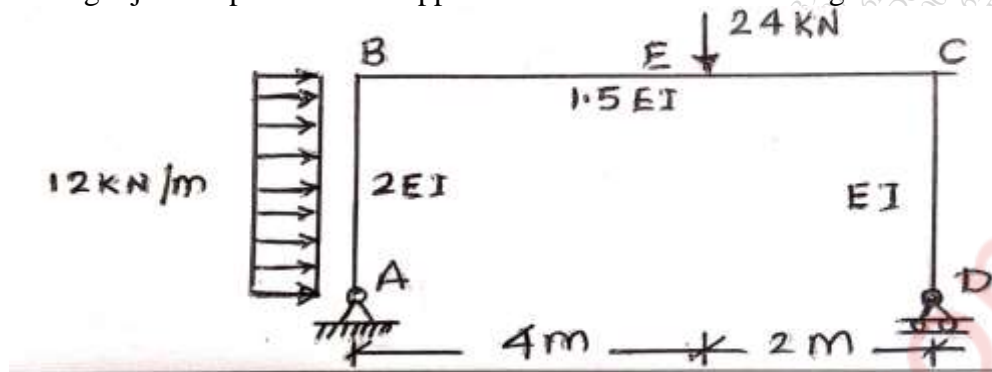
Q.5 (a) Draw ILDs for axial force in member CG, FG and CF of a through type bridge truss shown in figure. **6**



(b) Define the term ‘Shear Centre’ and its importance in structural analysis. **5**
 Also locate clearly the shear centre for a thin walled channel section shown in figure. Take uniform wall thickness as 8 mm.

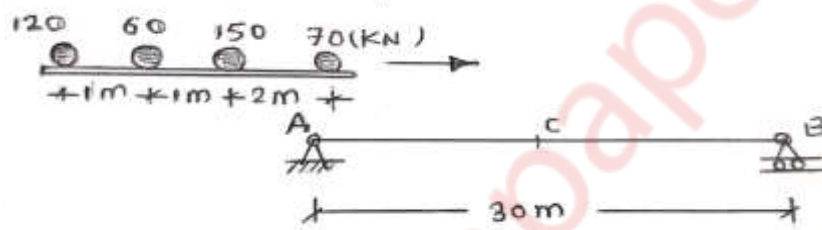


(c) Using **Virtual Work Method**, determine the horizontal deflection of joint **B** in a rigid jointed plane frame supported & loaded as shown in figure.



Q.6 (a) A simply supported girder of span 30 m is traversed by a system of wheel loads 120 kN, 60 kN, 150 kN & 70 kN spaced at 1 m, 1 m & 2 m respectively, moving from left to right with 70 kN leading load as shown in figure. Determine-

- (i) Maximum positive & negative SF at mid span section.
- (ii) Maximum BM at mid span.



(b) A suspension cable of span 120 m & central dip 12 m carries UDL of 10 kN/m over the entire span. Find the forces transmitted to the supporting pier-

- (i) If the cable passes over a smooth pulley fixed on the top of pier
- (ii) If the cable is clamped to a saddle with smooth rollers mounted on the top of pier.

For each of the above cases the anchor cable is inclined at 30° angle with horizontal.