**Q. P. Code :25896**

(3 Hours)   **(Max. Marks-80)**

N.B.
1) Question no.1 is **compulsory.** Attempt **any three** out of remaining five questions.
2) Figures to the write indicate full marks.
3) Assume suitable data if needed but justify the same.

Q.1   Answer **any four** from following-
     (a) State and explain-   5
        i.   Betti's theorem
        ii.   Castigliano's theorem.
     (b) Write Prof.Perry's formula, explaining the terms involved. Also state the   5
     importance of this formula over Secant formula.
     (c) A 3-hinged symmetrical parabolic arch is subjected to UDL over the entire span,   5
     Using the concept of ILD for bending moment (BM); prove that the BM at every
     section of the arch is zero.
     (d) Explain with neat sketches the terms-(i) Unsymmetrical bending (ii) Shear centre.   5
     Also state their significance in structural analysis.
     (e) Write the BM equation needed as per Macaulay's method for the beam loaded as   5
     shown-
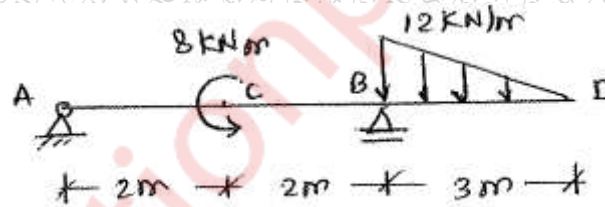
     (f) State & explain Moment Area Theorem-II. Also draw the conjugate beams for   5
   following real beams shown below-
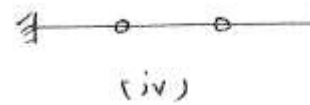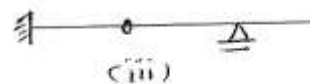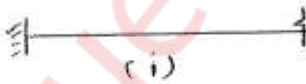
Q.2 (a) For a rigid jointed plane frame shown in figure, find support reactions and draw   10
FBD for all four members. Also draw AFD, SFD and BMD for the frame, indicating
important points. Note that there is internal hinge at 'B'.
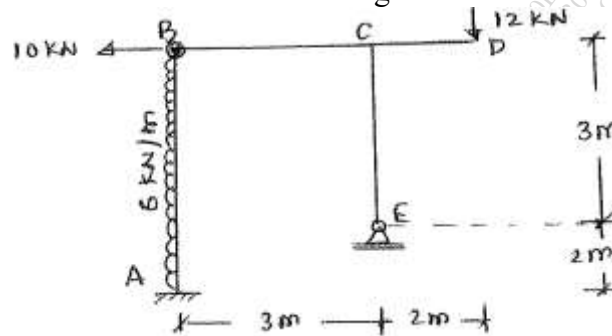
(b) An unsymmetrical 3-hinged parabolic arch is loaded as shown in figure.   10
Find-
   i.   The position of third hinge at 'C' above the left support.
   ii.   Support reactions.
   iii.   The position & magnitude of max +ve and max -ve BM in the arch.
       Also draw BMD for the arch.
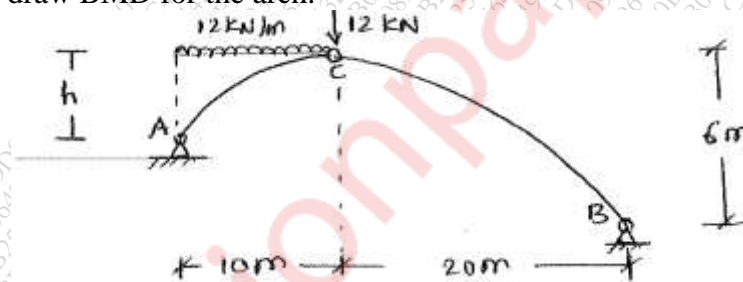
Q.3 (a) A pin jointed truss is loaded and supported as shown in figure. Determine the   10
horizontal deflection of joint 'C' using Unit Load Method.
Take axial rigidity AE = 30,000 KN for all members.

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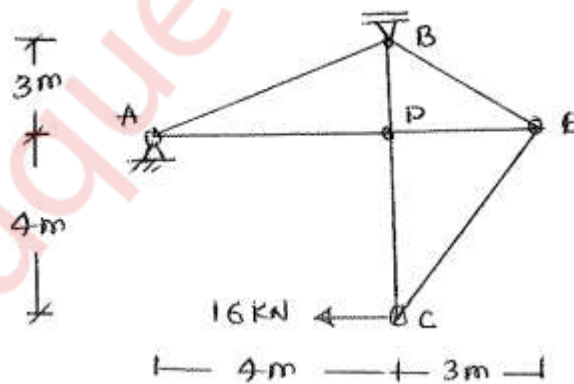
Q.3 (b) Using Moment Area Method **OR** Conjugate beam method, determine the location and magnitude of maximum deflection in a non-prismatic simply supported beam loaded as shown. — 10
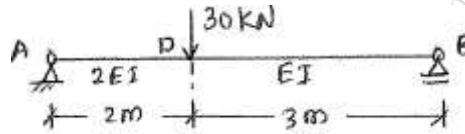

Q.4 a) A 3-hinged stiffening girder of a suspension bridge of span 120 m is subjected to two point loads of 180 KN and 240 KN at distances 30 m and 80 m respectively from left support. The supporting cable has a central dip of 12 m. Draw SFD & BMD for the girder, indicating important points. Also find maximum & minimum cable tension. — 12

(b) A simply supported girder of span 24 m is traversed by a series of five wheel loads 10 KN, 20 KN, 20 KN, 25 KN and 18 KN spaced at distances 3 m, 2 m, 2 m and 3 m respectively. If the load system is moving from left to right with 18 KN as leading load, find the location & magnitude of absolute maximum BM in the girder. — 8

Q.5 (a)) A hollow circular column of length 6 m, external diameter 200 mm and internal diameter 150 mm is fixed at both ends. If the column carries a load of 200 KN applied at distance 40 mm from column axis, determine extreme fibre stresses. Also sketch the stress distribution diagram. Take E for column material as 96 GPa. — 10

(b) The cross section of a 5 m long simply supported beam is a T-section having flange & web dimensions 120 mm x 20 mm and 20 mm x 180 mm respectively. The beam carries a central point load of 36 KN inclined at angle 30^0 (anti clockwise) with vertical axis of cross section. Find maximum compressive and maximum tensile at the critical section. Also draw the stress distribution diagram. — 10

Q.6 (a) Draw ILD for axial force in top member DE of a warren truss shown in figure. — 4
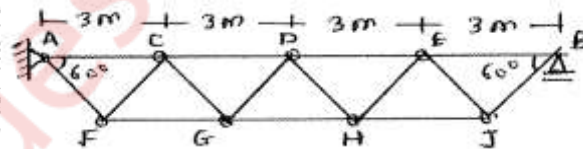
(b) A rod AB of uniform cross section is fixed at 'A' and is bent in vertical plane to give the shape of quadrant of a circle of radius 'R'. At free end B a horizontal load 'P' (rightwards) is applied. Determine- — 6
 i. Strain energy stored in the rod due to bending moment
 ii. Horizontal deflection at B. Assume EI=Constant.

(c) Determine horizontal deflection at joint 'B' in a rigid jointed plane frame loaded as   10
shown in figure. Take EI = 40,000 KNm^2. Use Virtual work method.

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