



Time: - 3 hrs.

Maximum Marks:- 80

N. B.

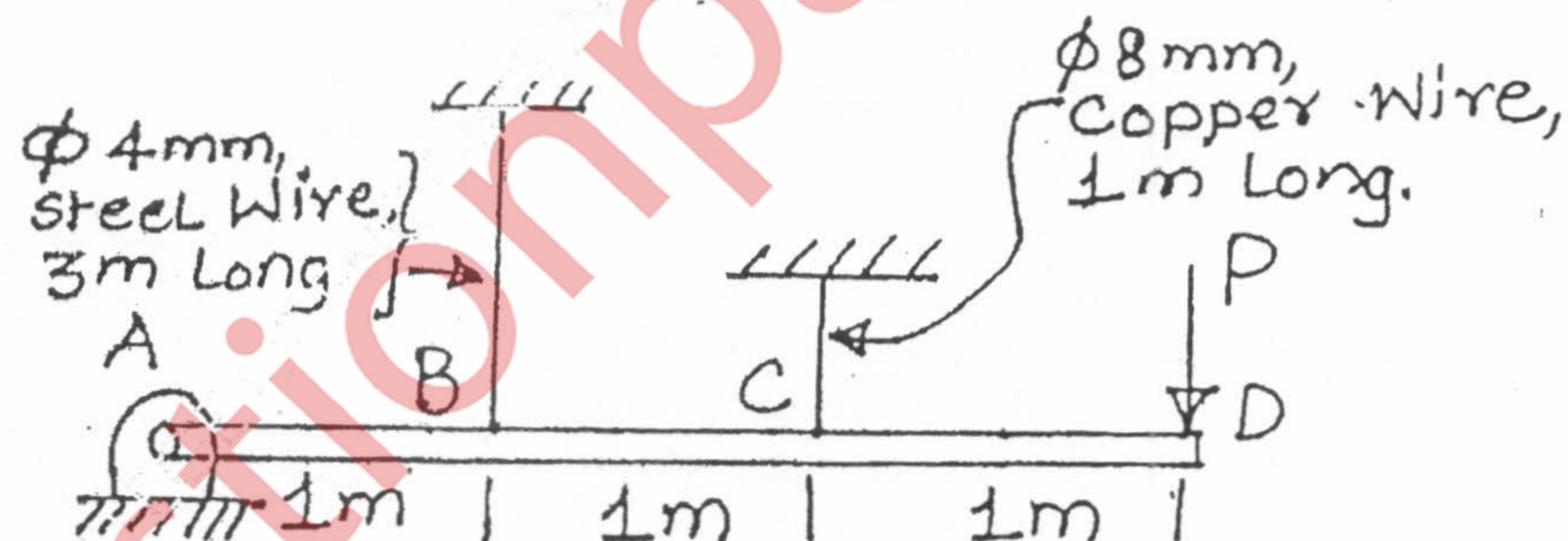
1. Question no. 1 is compulsory.
2. Answer any THREE out of the remaining FIVE questions.
3. Assumption made should be clearly stated.
4. Assume any suitable data wherever required but justify the same.
5. Answer to the questions should be grouped and written together.

Q1 Answer any four

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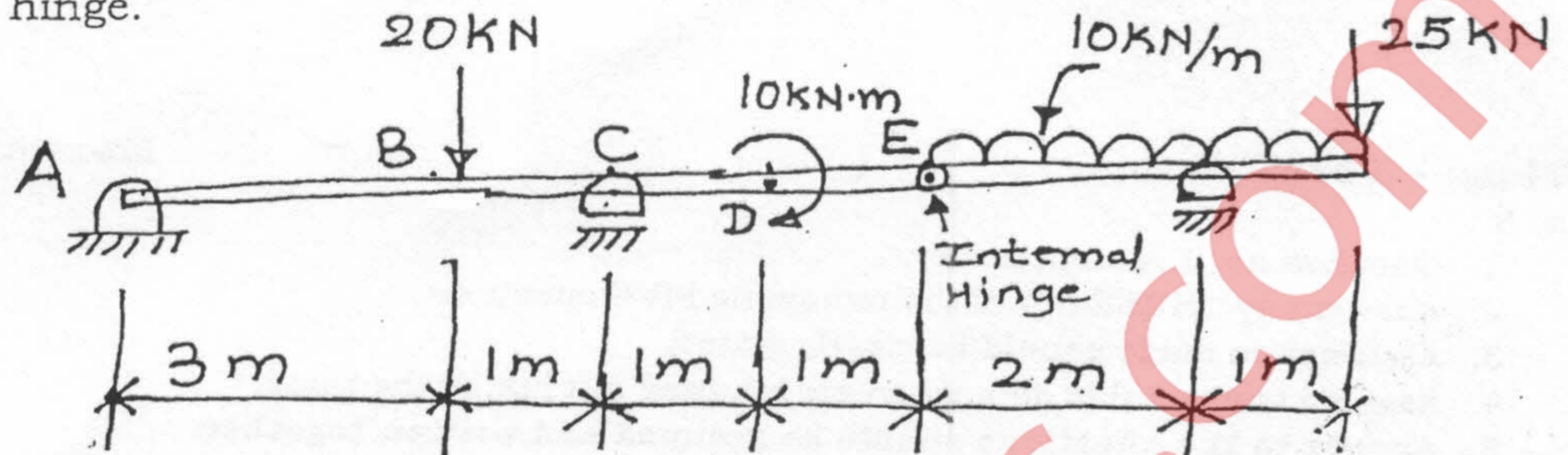
- a) A circular log of timber has diameter D . Find the dimensions of strongest rectangular section to resist moment, one can cut from this log.
- b) Explain beams of Uniform strength.
- c) Derive expression for deformation of uniformly Tapering Rectangular section bar.
- d) State at least three differences between Torque and Bending Moment.
- e) State the assumption made in theory of torsion.

- Q.2 a) Find the value of P , stress in steel and copper wires if the rigid beam AD rotates clockwise causing a deflection of 3 mm at the D . $E_s = 2 \times 10^5$ MPa, $E_c = 1 \times 10^5$ MPa. (10)



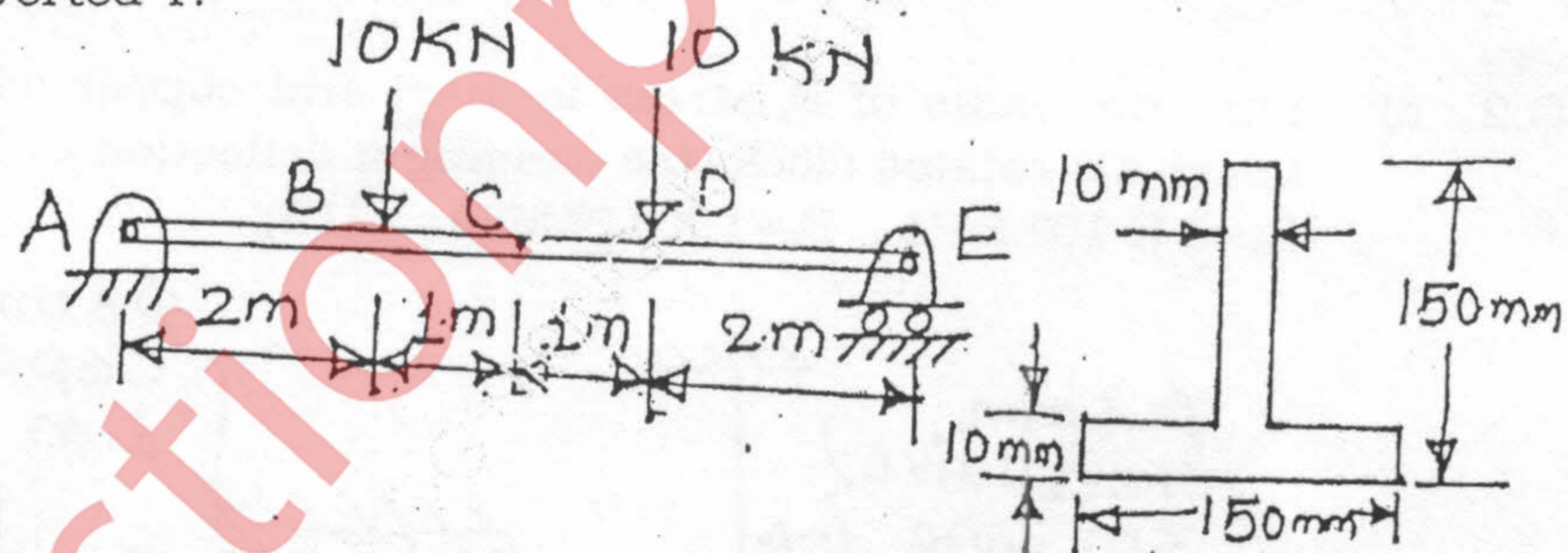
- b) A short hollow cylindrical column carries a compressive load of 450kN. Determine the maximum permissible eccentricity of load, if the allowable compressive stress is 75N/mm^2 & allowable tensile stress is 20N/mm^2 . The external and internal diameters are 200mm and 125mm respectively. Draw the variation of actual resultant stress across the section of the column.

- Q.3 a) Draw S.F.D. and B.M.D for the beam shown. E is an internal 10 hinge.

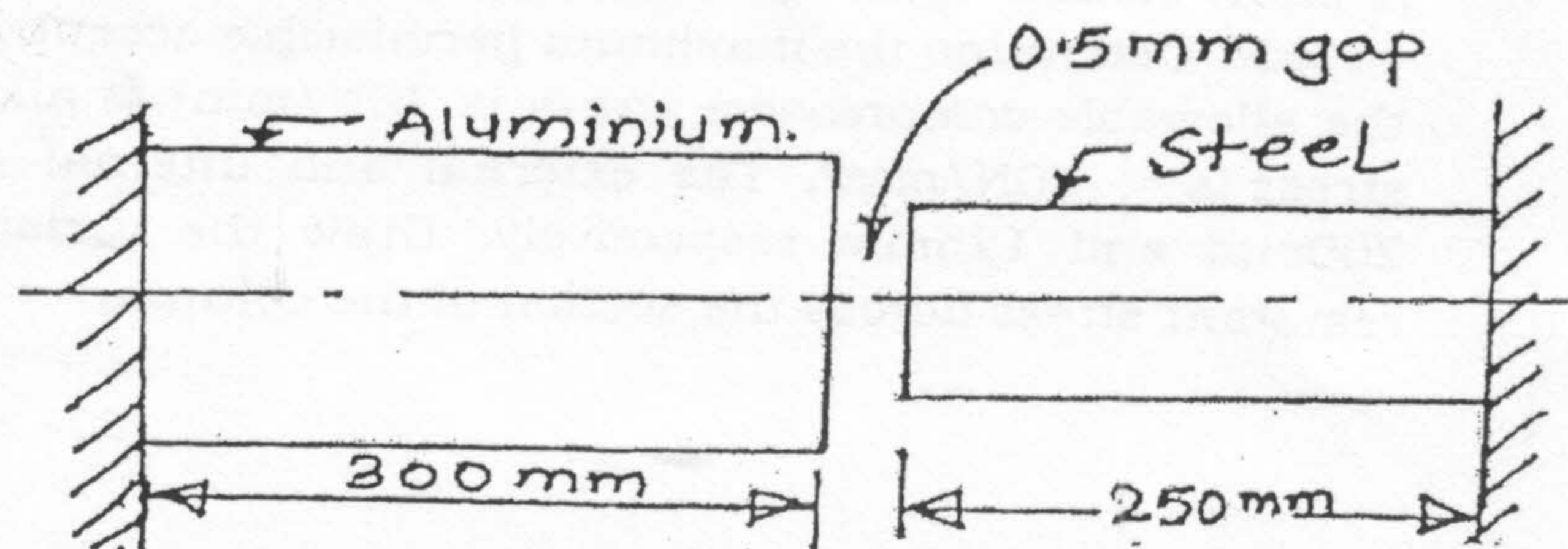


- b) The end of thin cylinder, 180 mm internal diameter and wall thickness 4 mm are closed by rigid plates and it is then filled with liquid. The cylinder is now subjected to an axial compressive force of 40 kN. Due to this the liquid pressure rises by 0.1 N/mm^2 . Assume $E = 2.1 \times 10^5 \text{ N/mm}^2$ and $\nu = 0.3$, calculate the bulk module of liquid.

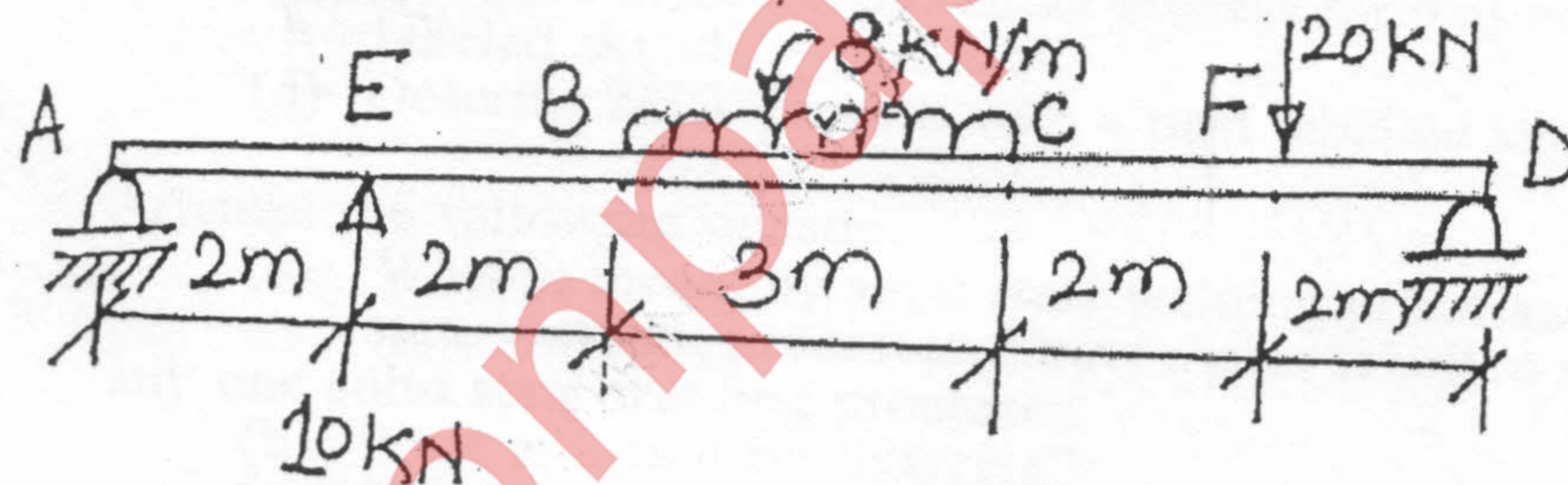
- Q.4 a) Find maximum bending stress at point C on the beam AE shown in figure. Note that the cross section of the beam is in the form of inverted T.



- b) At 20°C , a gap of 0.5 mm exists between the ends of rods as shown. Taking for aluminum $E_{AL} = 70 \text{ GPa}$, $\alpha_{AL} = 23 \times 10^{-6} / ^\circ \text{C}$, $A_{AL} = 2000 \text{ mm}^2$ and for steel $E_s = 190 \text{ GPa}$, $\alpha_s = 18 \times 10^{-6} / ^\circ \text{C}$, $A_s = 800 \text{ mm}^2$. When the temperature reaches 140°C determine:
- Normal stress in aluminum.
 - Exact length of aluminum rod.



- Q5 a) Determine the diameter of the shaft to transmit 1MW rotating at 220 rpm and the working conditions to be satisfied are: 10
- that the shaft not twist more than 1° on length of 12 diameters and
 - the shear stress must not exceed 60N/mm^2 . Take $C=84\text{KN/mm}^2$
- b) Find Euler's crippling load for hollow cylindrical column of 200 mm external diameter and 25 mm thick. Both ends of the column are hinged and length of the column is 6 m. Take $E= 8 \times 10^4 \text{ N/mm}^2$. Compare Euler's crippling load with Rankine's crippling load for the same column. Take $f_c=550 \text{ MPa}$ & $\alpha = 1/1600$. For what length of the column the critical loads by Euler's and Rankine's formula will be equal to each other. 10
- Q.6 a) Determine the deflection at B and the slop at D for simply supported beam as shown. Also find the maximum deflection and its location. Take $E= 2 \times 10^5 \text{ N/mm}^2$ and $I=300 \times 10^8 \text{ mm}^4$. 10



- b) The compound bar shown in figure consists of a 30mm diameter steel rod encased in a copper tube of internal diameter 30mm and external diameter 40mm. Find the stresses produced in steel and copper rod when a load of 100 N falls from a height of 40mm. Take $E_s=2 \times 10^5 \text{ N/mm}^2$, $E_c= 1 \times 10^5 \text{ N/mm}^2$ 10

