S.E. civil Sem III (Rev)
Strength of materials.
civil

- 4 DEC 2013

78 Con-code 5 - JP

Con. 8601-13. **GX-12098**

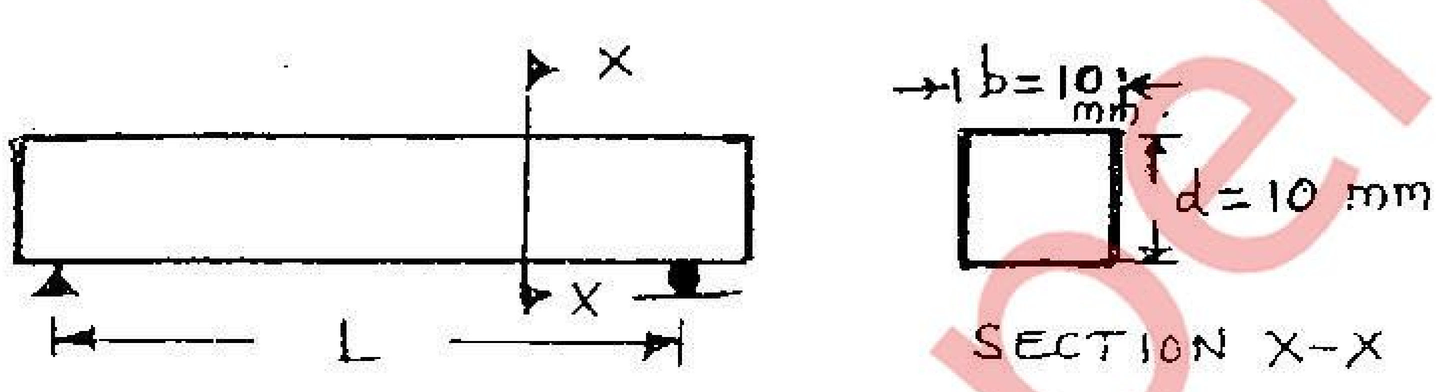
(3 Hours) [Total Marks : 80

N. B.: (1) Question No. **1** is **compulsory**.
(2) Answer any **three** from the **remaining**.
(3) Each **full** question carries **20** marks.
(4) Assume **suitable** data, if needed and state it **clearly**.

Q. 1. Answer any **five**: (20 M)

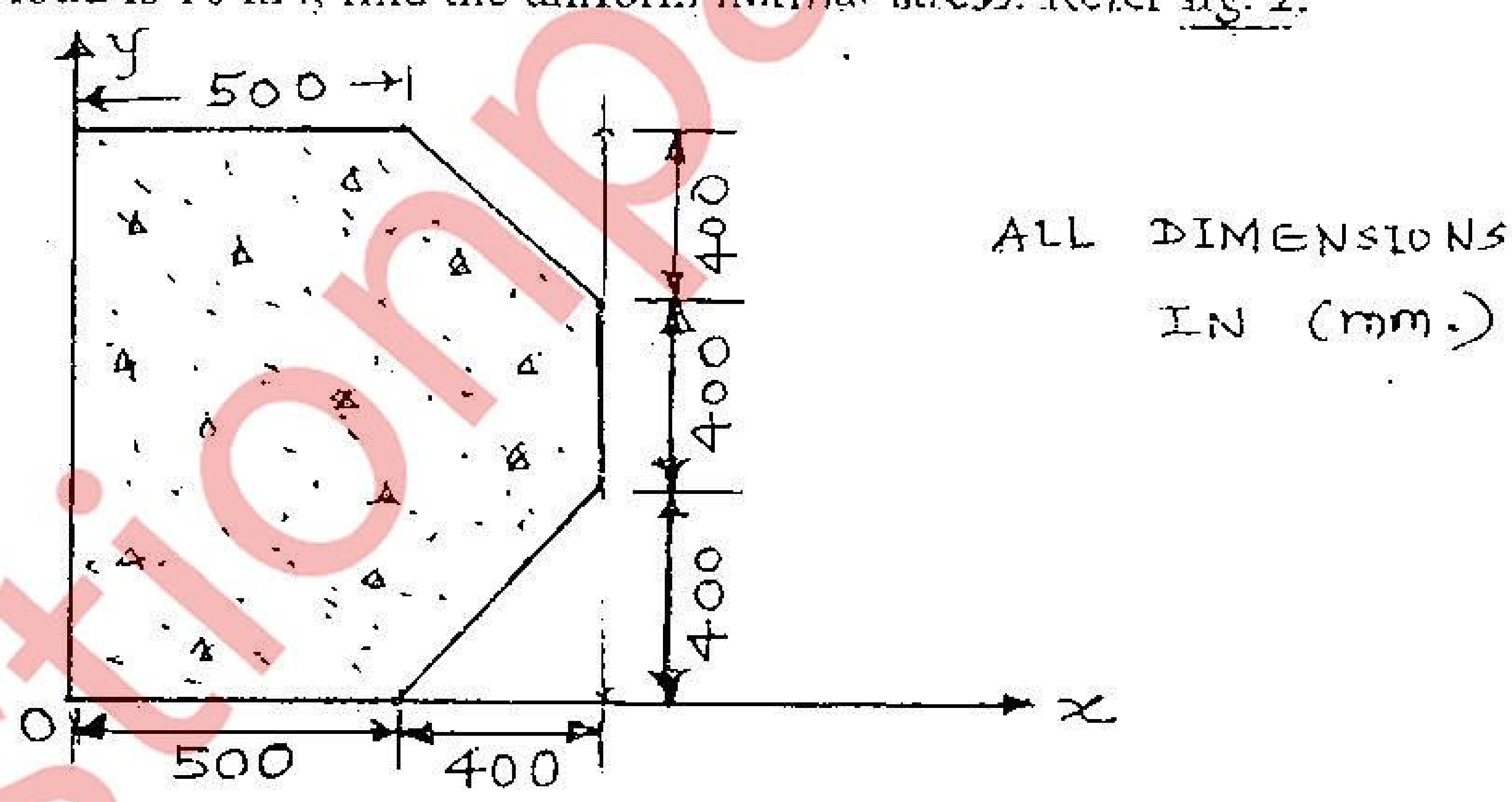
a) Calculate the Moment of Inertia for the beam in fig. 1. Keeping the same cross-sectional area, if the depth is made twice the width, calculate the moment of inertia. By doing so, load carrying capacity of the beam increases or decreases?

FIG. 1



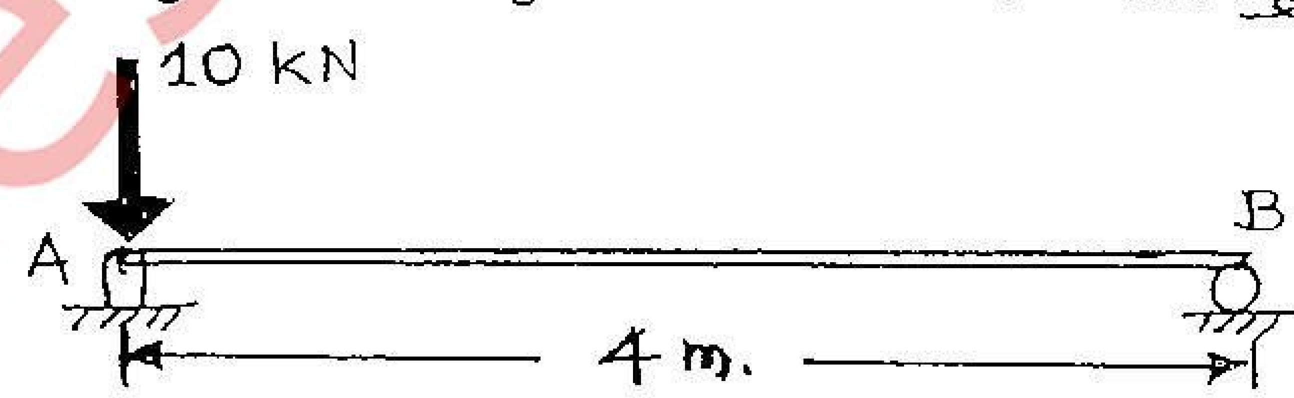
b) Determine the coordinates x & y of the point where the resultant load must act in order to produce uniform normal stress. If the load is 10 kN, find the uniform normal stress. Refer fig. 2.

FIG. 2
CONCRETE COLUMN



c) Draw Shear Force & Bending Moment Diagrams for the Beam shown in fig. 3.

FIG. 3



d) Define Bulk Modulus & Poisson's ratio.

e) State the assumptions made in Euler's theory of column buckling.

f) For a rectangular C/S of width B & depth D, locate Core or Kernel of the section. What is its significance?

g) Derive an expression for the strain energy in a member subjected to an axial force.

[TURN OVER

Q. 2. a) The 1.35 m. concrete post of diameter 0.45 m. is reinforced with 6 steel bars, each with a 28 mm. diameter. E_{steel} = 200 GPa & $E_{concrete}$ = 29 GPa. Find the normal stresses in the steel & in the concrete when a 1560 kN axial centric force P is applied to the post. Refer fig. 4. (07M)

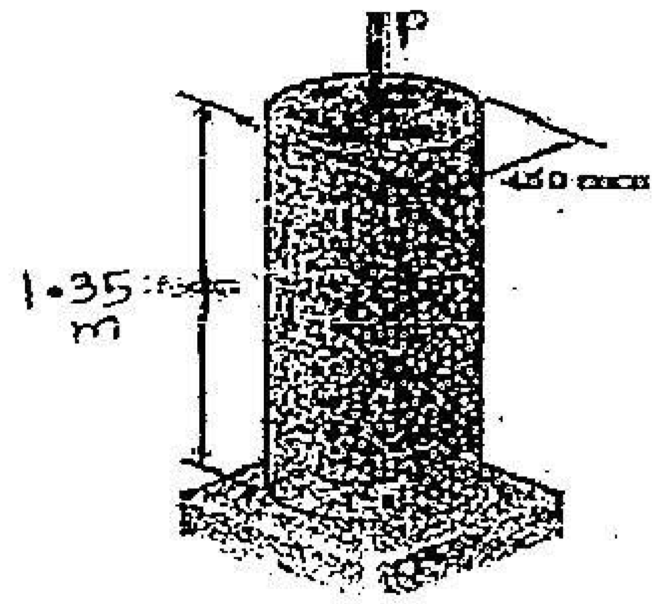
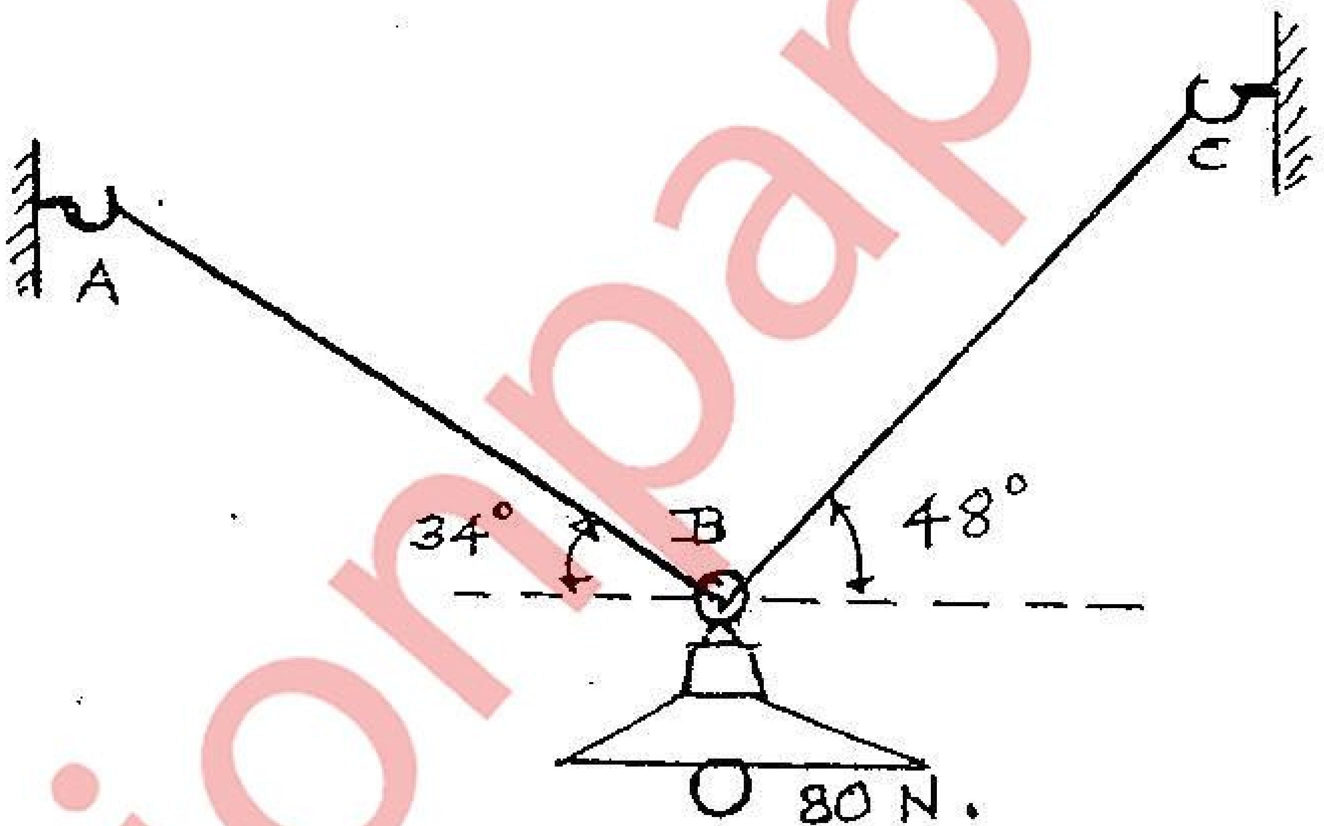


FIG. 4

b) Two steel wires AB & BC support a lamp weighing 80 N (fig.5). Both wires have diameter 0.75 mm. Determine the tensile stresses in wires AB & BC. (06 M)

FIG. 5



c) Three different materials designated A, B & C are tested in tension using test specimens having diameters of 12.625 mm & gauge length of 50 mm (fig. 6). At failure, the distances between the gauge marks are found to be 53.25 mm, 62 mm & 69.5 mm respectively. Also, at the failure cross-sections, the diameters are found to be 12.1 mm, 9.95 mm & 6.325 mm respectively. Determine the percent elongation & percent reduction of area of each specimen & then using your judgment, classify each material as brittle or ductile. (07 M)

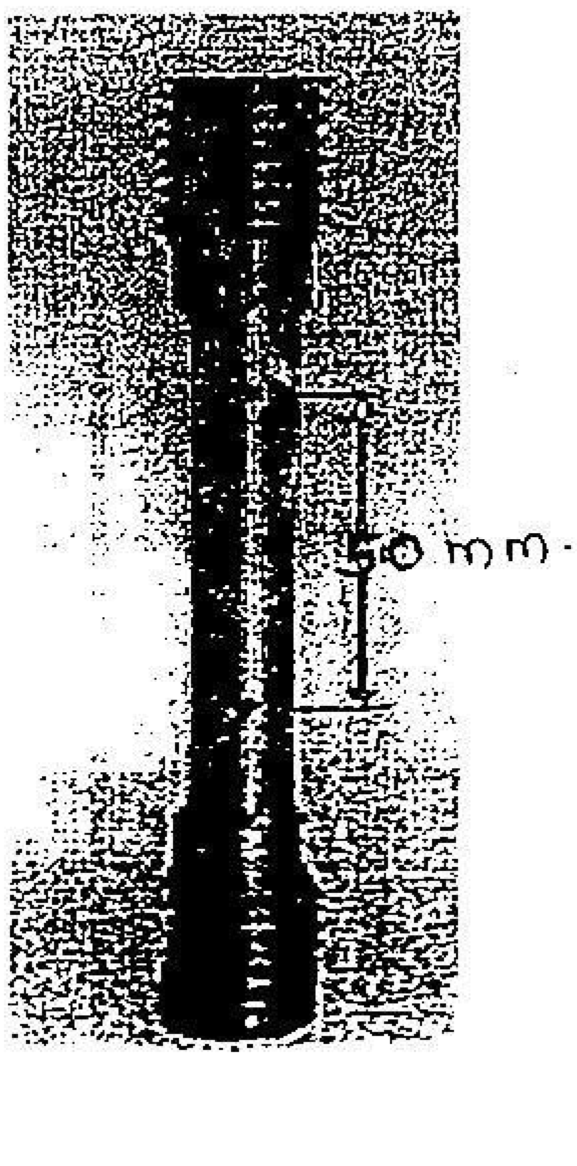


FIG. 6

Q. 3. a) Draw SFD & BMD for the timber beam in fig. 7. (12 M)

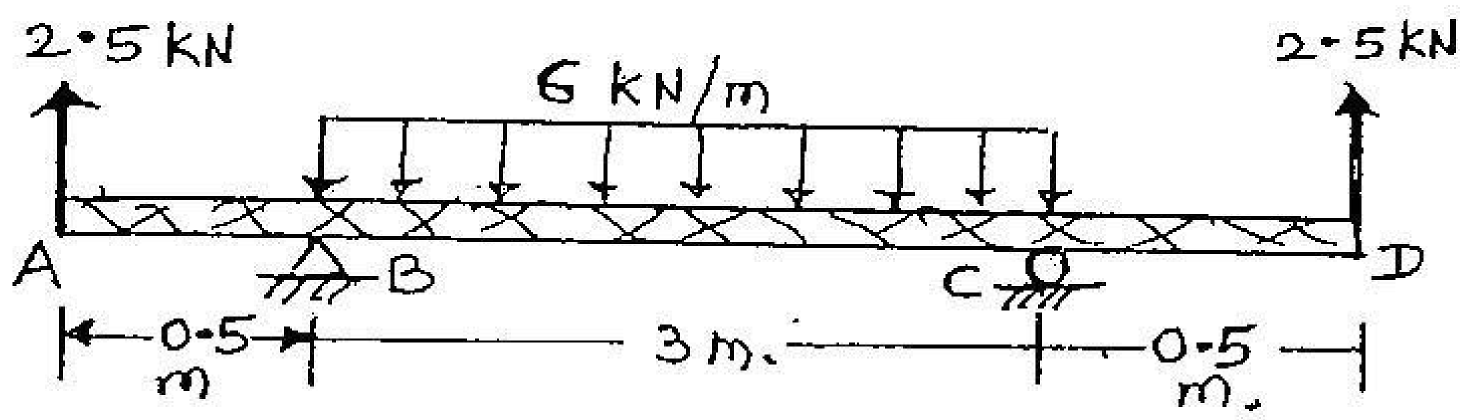
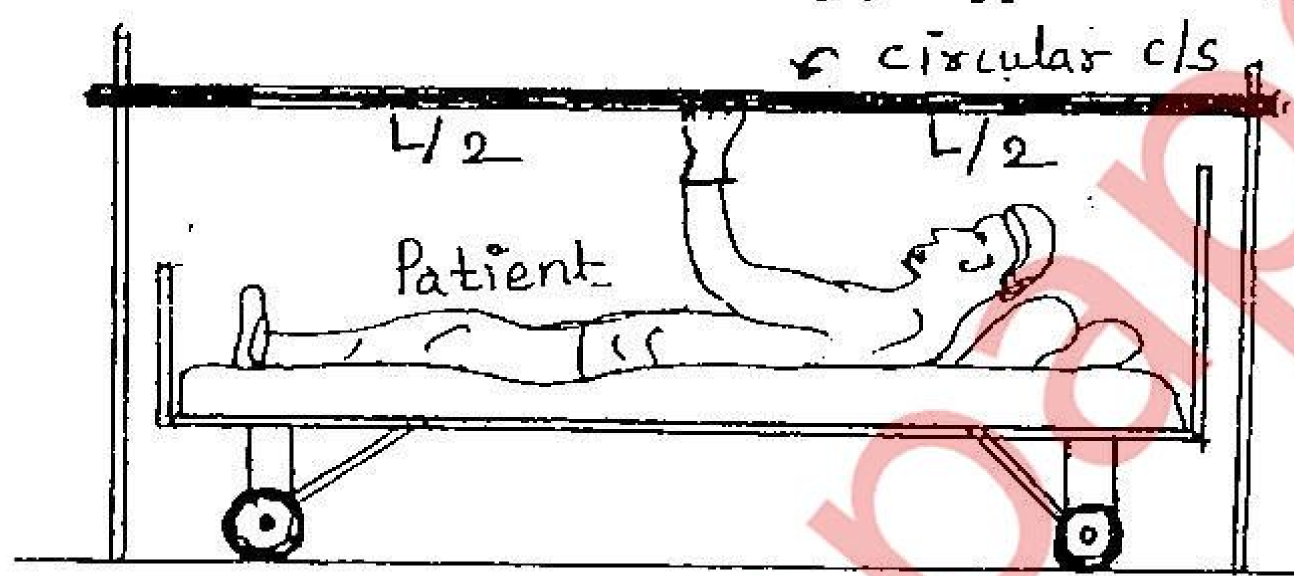


FIG. 7

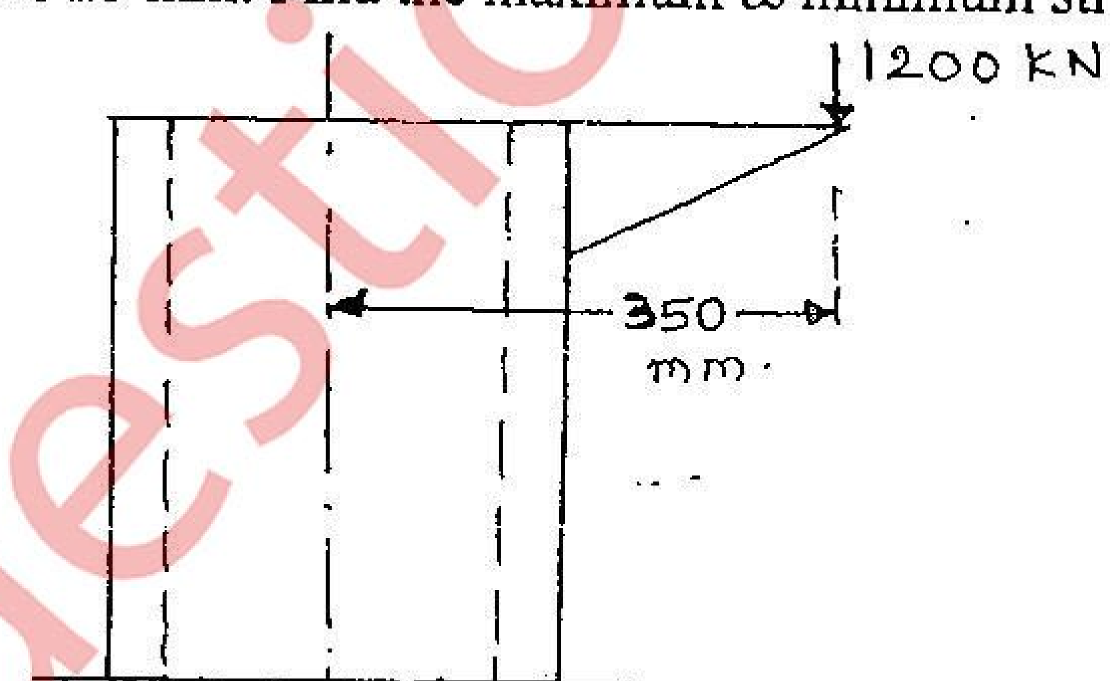
b) A so-called "trapeze bar" in a hospital room provides a means for patients to exercise while in bed (fig. 8). The bar is 2.1 m. long & has a solid circular C/S. The design load is 1.2 kN applied at the mid-point of the bar & the allowable bending stress is 200 MPa. Determine the diameter of the bar to be provided. (Assume that the ends of the bar are simply supported & that the weight of the bar is negligible). (08 M)

FIG. 8



Q. 4. a) A short CI column of hollow circular section has a projecting bracket (fig.9). It carries a load of 1200 kN. The load line is off the column axis by 350 mm. The external diameter of column is 320 mm & the metal thickness is 25 mm. Find the maximum & minimum stresses in the section. (08 M)

FIG. 9



b) A solid circular shaft transmits 75 kW power at 200 RPM. Calculate the shaft diameter if the twist in the shaft is not to exceed 1^0 in 2 meters length of shaft & shear stress is limited to 50 MN/m^2. Take modulus of rigidity = 100 GN/m^2. (08 M)

c) A thin cylindrical shell 3.2 m long is having 1.2 m internal diameter & 15 mm thick. Calculate hoop stress, longitudinal stress & maximum shear stress, if internal fluid pressure = 1.6 MPa. E = 200 GPa & Poisson's ratio = 0.3. (04 M)

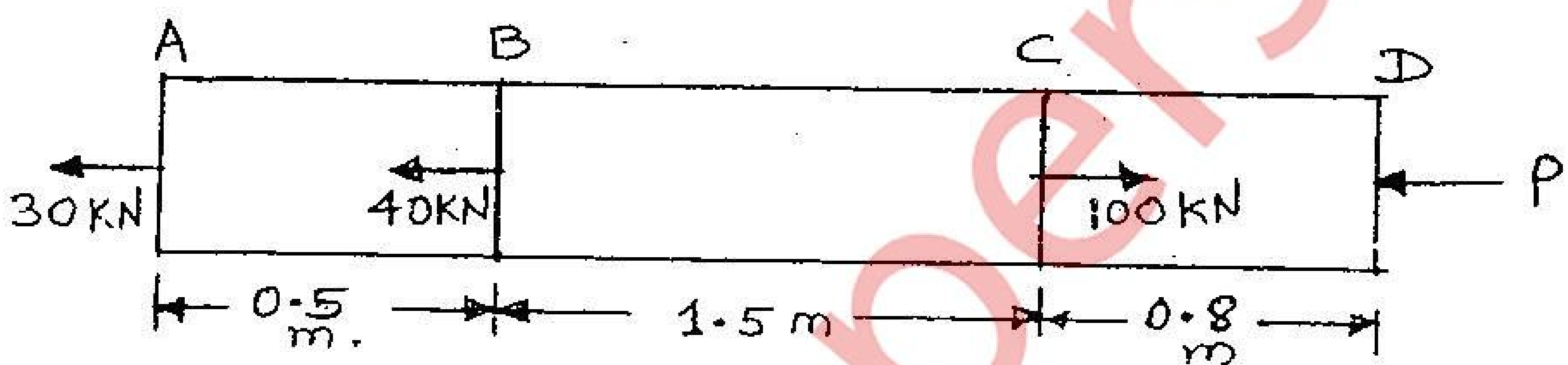
Q. 5. a) An element in a stressed material has tensile stress of 500 MN/m^2 & compressive stress of 350 MN/m^2 acting on two mutually perpendicular planes & equal shear stresses of 100 MN/m^2 on these planes. Find principal stresses & position of the principal planes. Find also maximum shear stress. Use either analytical method or graphical method. (10 M)

b) A hollow cylindrical column is fixed at both ends. The column length is 4.2 m & it carries an axial load of 260 kN. Design the column by Rankine's approach. Adopt a factor of safety of 4.5. The internal diameter = 0.8 X external diameter. Take crushing stress for material = 560 MPa & Rankine's constant = (1/1600). (10 M)

Q.6. a) A T-section having flange (200 mmX50 mm) & web (200 mmX50 mm) is subjected to a vertical shear force of 120 kN. Calculate the shear stress at the neutral axis & at the junction of the web & the flange. Take depth of the NA from the top edge = 87.5 mm & I = 0.0001134 m^4. (07 M)

b) A steel bar having cross-sectional area 1100 mm^2 is subjected to axial forces (fig. 10). Find the change in the bar length. E = $2X10^5$ MPa. (04M)

FIG. 10



c) A steel tube of 30 mm external diameter & 20 mm internal diameter encloses a copper rod of 20 mm diameter. They are rigidly fixed at the ends at a temperature of 10^0 C. calculate the stresses in the rod & tube when temperature is raised to 210^0 C. E_{steel} = 2.1 X 10^5 MPa & E_{copper} = $1X10^5$ MPa. Take α for copper = $18X10^{-6}$ per ^{0}C & α for steel = $11X10^{-6}$ per ^{0}C. (05 M)

d) The ship at A has just started to drill for oil on the ocean floor at a depth of 1500 m. Knowing that the top of the 200 mm diameter steel drill pipe (modulus of rigidity = 77 GPa) rotates through 2 complete revolutions before the drill bit at B starts to operate, determine the maximum shearing stress caused in the pipe by torsion. Refer fig. 11. Neglect the water effect. (04 M)

FIG. 11