S.E. (Mechanical) (Sem -III) (CB)

Paper / Subject Code: 51603 / Strength of Materials          Date - 20/11/19

(3 Hours)                                             [Total Marks: 80]

N.B.    1. Question No.1 is compulsory.
        2. Answer any three questions from remaining questions.
        3. Assume suitable data if required.
        4. Figure to the right indicates full marks.

Q.1     Answer any four of the following.                                        20
    a.  Derive an expression for the strain energy due to suddenly applied load.
    b.  Derive the relation between load, shear force and bending moment.
    c.  Write the assumptions made in theory of pure torsion and derive torsional
        formula.
    d.  Draw shear stress distribution diagram for symmetry I section, T section and
        rectangular section.
    e.  Write the assumption for simple bending and derive the flexural formula.
    f.  Find the maximum power that can be transmitted through 50 mm diameter shaft at 150
        rpm. if the maximum permissible shear stress is 80 N/ mm$^2$.

Q.2   A bar of brass 20 mm is enclosed in a steel tube of 40 mm external diameter and    10
  a.  20 mm internal diameter. The bar and the tubes are initially 1.2 m long and are
      rigidly fastened at both ends. If the temperature is raised by 60°C, find the
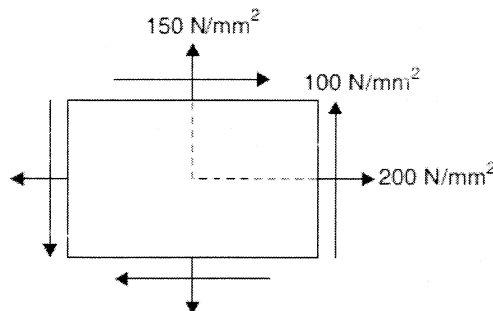      stresses induced in the bar and tube.
      Given: Es = 2 × 10$^5$ N/mm$^2$
      Eb = 1 × 10$^5$ N/mm$^2$
      $\alpha_s$ = 11.6 × 10$^{-6}$/°C
      $\alpha_b$ = 18.7 × 10$^{-6}$/°C.

  b.  The state of stress at a point in a strained material is as shown in Fig. Determine    10
      (i) the direction of principal planes
      (ii) the magnitude of principal stresses and
      (iii) the magnitude of maximum shear stress.
      Indicate the direction of all the above by a sketch.
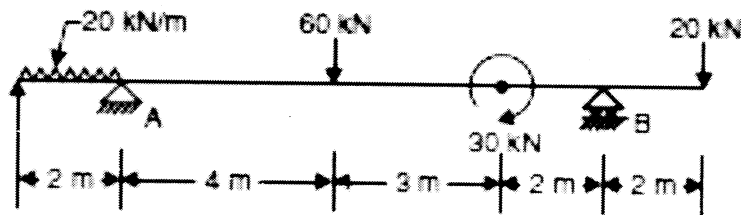


Q.3 a. Find slope at point A & B deflections at points C & D for a beam as shown in fig.    10
       Also find the maximum deflection. Take, E=200 GPa & I=10$^8$ mm$^4$
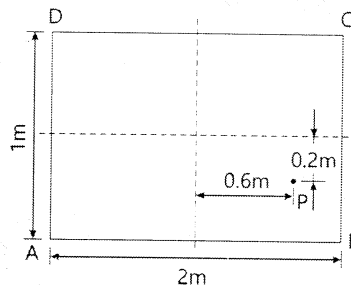
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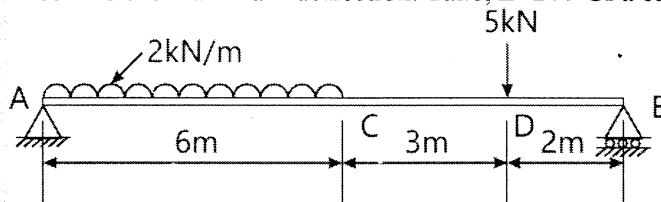
b. Draw SF and BM diagrams for the beam shown in figure. 10



Q.4
a. A vertical column of rectangular section is subjected to a compressive load of 10
P=800 KN as shown in fig. Find the stress intensities at the four corners of the column.



b. A propeller shaft is required to transmit 50 kW power at 500 rpm. It is a hollow 10
shaft, having an inside diameter 0.6 times of outside diameter and permissible
shear stress for shaft material is 90 N / mm². Calculate the inside and outside
diameters of the shaft.

Q.5
a. A cylindrical shell is 3m long and 1.2m in diameter and 12mm thick is subjected 10
to internal pressure of 1.8 N/mm² calculate change in dimensions and volume of
shell. Take E=210 kN/mm² 1/m=0.3

b. A simply supported beam of length 3 m and a cross section of 100 mm×200 mm 10
carrying a UDL of 4 kN/m. find
    1. Maximum bending stress in the beam.
    2. Maximum shear stress in the beam.
    3. The shear stress at point 1 m to the right of the left support and 25 mm below
       the top surface of the beam.

Q.6
a. A 400 mm long bar has rectangular cross-section 10 mm × 30 mm. This bar is 10
subjected to
(i) 15 kN tensile force on 10 mm × 30 mm faces,
(ii) 80 kN compressive force on 10 mm × 400 mm faces, and
(iii) 180 kN tensile force on 30 mm × 400 mm faces.
Find the change in volume if E = 2 × 105 N/mm² and 1/m= 0.3.

b. A hallow cylindrical CI column is 4 m long with both end fixed. Determine the minimum 10
diameter of the column, if it has to carry a safe load of 250 KN with a FOS of 5. Take
internal diameter as 0.8 times the external diameter E=200 GN/m².

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Q.P.Code:**70863**

Q 2  a. A bar of brass 20 mm diameter instead of a bar of brass 20 mm
Q 3  b.  Fig. show a extreme right side vertical line is a dimension line not a support or force line.

couple shown on a fig. 30 kN-m   instead of 30 kN.

Q 4 a. four corners instead of four comers.

Q 6 a. $E = 2 \times 10^{5}$ $N/mm^{2}$ instead of $2 \times 105$ $N/mm^{2}$.