Printed Pages : 4   TME303

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4071   Roll No. [ ][ ][ ][ ][ ][ ][ ][ ][ ]

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10
STRENGTH OF MATERIAL

Time : 3 Hours]   *[Total Marks : 100*

Note :   *Attempt all questions.*

1   Attempt any **two** parts of the following :

   (a)   Derive compatibility equations in Cartesian   **10**
co-ordinates.

   (b)   A solid circular shaft is required to carry   **10**
a torque 40 kNm and a bending moment
30 kNm. If yield stress σ_y in a simple
tensile test on a material of the shaft was
found to be 260 N/mm^2, find the minimum
required diameter of the shaft according to
different theories of failure. Take a factor
of safety F.S. = 2.5 and Poisson's ratio = 0.3.

   (c)   The state of stress at a point is given by   **10**
the following array of terms :

$$\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix} \text{ MPa}$$

Determine the principal stresses and
direction cosines of maximum principal stress.

JJ-4071]   1   [Contd...

Attempt any **two** parts of the following :

(a) Mentioning Assumptions involved derive   **10**
Bending Equation (Flexural formula).

(b) The simply supported beam shown in Fig.1   **10**
has a flexural rigidity $EI = 8 \times 10^6 \text{ Nm}^2$.
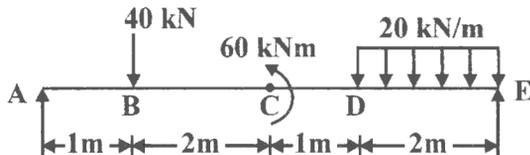Find deflection at 'C' and 'D'.

Fig. 1

(c) A hollow steel shaft 4 m long is to transmit   **10**
150 kW power at 150 RPM. The total angle
of twist in this length is not to exceed 2.5^o
and the allowable shear stress 60 N/mm².
Determine the inside and outside diameters,
if $N = 0.082 \times 10^6 \text{ N/mm}^2$.

3   Attempt any **two** parts of the following :

(a) Derive critical loads on the basis of Euler's   **10**
method for column with both ends hinged.

(b) A close-coiled helical spring is to have a   **10**
stiffness of 100 N/m in compression, with
a maximum load of 45 N and a maximum
shearing stress of 120 N/mm². The solid
length of the spring (i.e. coils touching) is
45 mm, find :

(i) The wire diameter

(ii) The mean coil radius and

(iii) The number of coils.

Take C = 0.4×10^5 N/mm²

(c) A short column of hollow cylindrical section has outer diameter 300 mm and inner diameter 200 mm and carries a load of 300 kN at a distance of 80 mm from the centre of the column.

  (i) Find the extreme stresses and draw the stress diagram.

  (ii) What should be the maximum eccentricity so that no tension develops in the column?

4 Attempt any **two** parts of the following :

  (a) In a thin-walled cylindrical shell, determine Hoop stress or circumferential stress, Longitudinal stress, Hoop strain and Longitudinal strain. 10

  (b) A spherical tank has a diameter of 20 m and wall thickness 15 mm. If the permissible stress in the material is 120 MPa, find the maximum pressure at which a gas can be stored in the tank. Find the increase in diameter and volume of the tank due to the gas pressure. Take $E = 200$ GPa and Poisson's ratio $= 0.3$. 10

  (c) A cylindrical pressure vessel of external and internal radii 0.3 m and 0.2 m respectively is subjected to an internal hydraulic pressure of 20 N/mm^2. If $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$, find the stresses at the internal and external surfaces and calculate the change in internal and external diameters. 10

Attempt any **two** parts of the following :

(a) Describe briefly :   10

   (i) Bending of beams with large initial curvature

   (ii) Unsymmetrical bending.

(b) A curved bar of rectangular cross-section has   10 width 40 mm and depth 60 mm and has a radius of curvature 80 mm about the centroidal axis parallel to width. Find the bending streses at the inner and outer faces caused by a moment of 500 Nm tending to increase the curvature.

(c) For a channel section shown in Fig. 2, find   10 the shear stress at the junction of the flange and the web and at the centre of the web due to a shear force of 50 kN. Locate the shear centre.
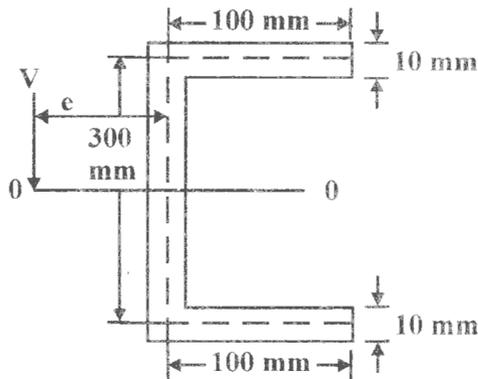

Fig. 2

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