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(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 co-ordinates. **10**

(b) A solid circular shaft is required to carry 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. **10**

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

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

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

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

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

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

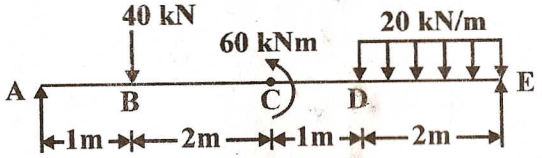

Fig. 1

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

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

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

(b) A close-coiled helical spring is to have a stiffness of 100 N/m in compression, with a maximum load of 45 N and a maximum shearing stress of 120 N/mm^2. The solid length of the spring (i.e. coils touching) is 45 mm, find : **10**

(i) The wire diameter

(ii) The mean coil radius and

(iii) The number of coils.

Take C = 0.4 × 10^5 N/mm^2

(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. **10**

(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 × 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**

5 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 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. **10**

(c) For a channel section shown in Fig. 2, find 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. **10**

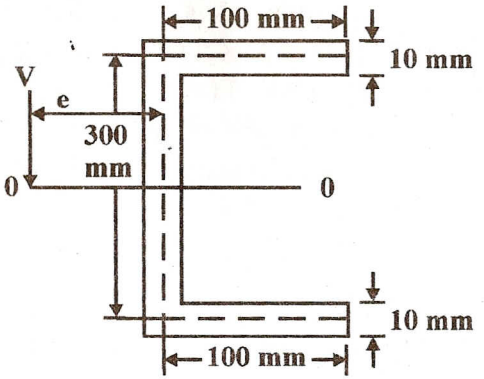

Fig. 2