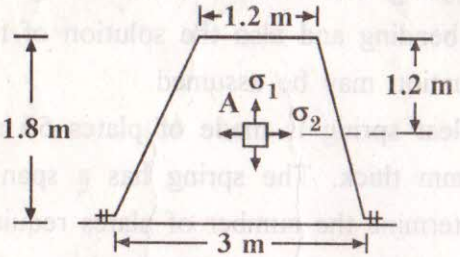
(c) A truncated conical tank having the dimensions shown in Fig. is filled with water (w =1 gm/cm^3) Calculate the membrane stresses σ_1 and σ_2 for an element A of the wall situated as shown in the figure, if $t = .3\ mm$



5 Answer any **two** of the following : 10×2=20

(a) Derive the equation to find the position of neutral axis for the following cross sections of curved beam :

(1) Rectangular section

(2) Circular cross section.

(b) What is shear centre ? Prove that the shear centre for a thin-walled balanced z section coincides with its centroid.

(c) Determine the numerical value of the ratio $\sigma_{max}/\sigma_{min}$ for the case of plane bending of a curved beam having 2.5 × 2.5 cm. square cross section if the radius of curvature of the centroidal axis is R = 3.75 cm.

Printed Pages : 4 TME-303

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

PAPER ID : 4071 Roll No.

B. Tech.

(SEM. III) EXAMINATION, 2007-08

STRENGTH OF MATERIAL

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

Note : *(1) Answer all the questions.*

(2) Suitably assume data missing, if any.

1 Answer any **three** of the following : 6×3=18

(a) State the generalized Hook's law and prove for an anisotropic elastic material the maximum number of elastic constants is 21 only. Also show that for isotropic materials it is 2.

(b) State Castigliano's first and second theorems for strain energy. What are their uses ?

(c) Derive an expression for strain energy in cantilever due to bending and shear under a concentrated edge load ?

(d) Derive the equation of equilibrium in z-direction, by considering the equilibrium of an infinitesimal rectangular element of size $dx\ dy\ dz$ in the Cartesian co-ordinate system as

$$\frac{\partial \sigma_z}{\partial z} + \frac{\partial \tau_{xz}}{\partial x} + \frac{\partial \tau_{yz}}{\partial_y} + \bar{z} = 0$$

(e) At a point in a body, the displacement field is linear and is given by the following expressions. Find all the strains :

$$u = 0.07x + 0.05y + 0.01z$$
$$v = 0.01y - 0.04x$$
$$w = 0.02x + 0.02z$$

2 Answer any **three** of the following : **7×3=21**

(a) What are the assumptions made in the simple theory of bending ?

(b) Derive the deflection equation for cantilever beam with uniformly distributed load.

(c) Determine the dimensions of hollow shaft with a diameter ratio of 3:4, which is to transmit 60 kN at 200 rev/min. The maximum shear stress in the shaft is limited to 70 MN/m^2 and the angle of twist to 3.8° in a length of 4 m. For the shaft material, G=80 GPa.

(d) Determine equivalent bending moment for the shafts subjected to combined bending and torsion.

(e) In a thin circular tube show that the maximum shear stress is twice the average shear stress over the cross-section.

3 Answer any **three** of the following : 7×3

(a) An open coiled spring carries an axial load W, show that the deflection is related to W by $\delta = \frac{8Wn\,D^3}{G\,d^u}K$ where K is a corrective factor which allows for the inclination of the coils, n = number of effective coils, D = mean coil diameter and d = wire diameter.

(b) Explain middle quanta and middle third rules ? What are the importance of these rules for concrete sections ?

(c) State the assumptions made during the Euler's formula for a strut with pin jointed ends. Derive the Euler's crippling load for such a strut - the general equations of bending and also the solution of the differential equation may be assumed.

(d) A leaf spring is made of plates 50 mm wide and 8 mm thick. The spring has a span of 700 mm. Determine the number of plates required to carry a central load of 45 kN. The maximum allowable stress in the plates is 200 MPa. What is the maximum deflection under this load ?

4 Answer any **two** of the following : **10×2=20**

(a) Derive the Lame equations for the hoop and radial stresses in a thick cylinder subjected to an internal and external pressure and show how these may be expressed in graphical form.

(b) A laminated thick walled hydraulic cylinder was fabricated by shrink-fitting a steel (E = 200 GPa and μ =0.30) jacket having an outside diameter 300 mm onto steel tube with an inside diameter of 100 mm and an outside diameter of 200 mm. The interference was 0.15 mm.

(1) Determine the interfacial contact pressure

(2) Determine the maximum tensile stress in the laminated cylinder resulting from the shrink fit.