Code: 9D15103

M.Tech I Semester Regular & Supplementary Examinations January/February 2017

ADVANCED MECHANICS OF SOLIDS

(Machine Design)

Time: 3 hours Max. Marks: 60

Answer any FIVE questions

All questions carry equal marks

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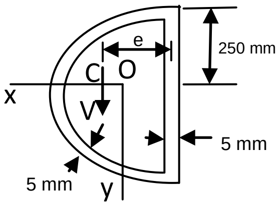
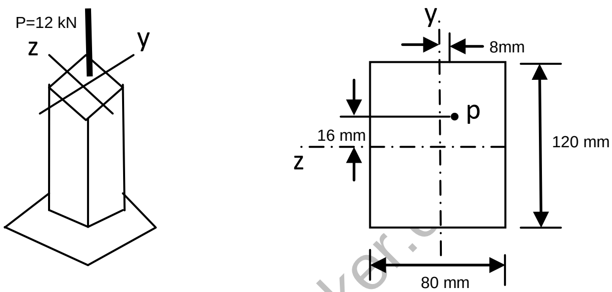
1 Determine the shear center location C for an aircraft semi-circular box beam whose cross section is shown in figure blow.



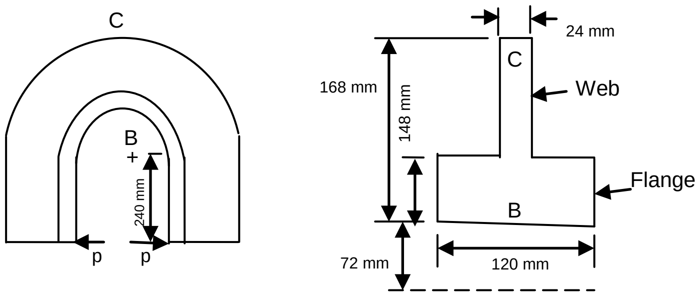
2 The masonry column carries an eccentric load P = 12 kN as shown in the figure below:



(a) Locate the points on the cross section where the neutral axis crosses the y- and the z-axes.

(b) Determine the maximum tensile and compressive normal stresses.

3 The curved beam in figure is subjected to a load P = 120 kN. The dimensions of section BC are also shown in figure below. Determine the circumferential stress at B and radial stress at the junction of the flange and web at section BC.



4 (a) What is Prandtl elastic membrane analogy? Explain.

(b) A rod with rectangular cross section is used to transmit torque to a machine frame with a width of 40 mm. The first 3 m length of the rod has a depth of 60 mm, and the remaining 1.5 m length has a depth of 30 mm. The rod is made of steel for which G = 77.5 GPa. For T_1 = 750 N-m and T_2 = 400 N-m, determine the maximum shear stress in the rod. Determine the angle of twist of the free end.

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5 Derive the stresses for two bodies in line contact **:** Loads normal and tangent to contact area.

6 (a) What is plane stress and plane strain? Explain with suitable example.

(b) For a solid in a state of plane stress, show that if there are body forces P_x, P_y per unit volume in the direction of the axes x, y respectively, the compatibility equation can be expressed in the form:

$$\nabla^2(\sigma_{xx} + \sigma_{yy}) = -(1+\nu)\left(\frac{\partial p_x}{\partial x} + \frac{\partial p_y}{\partial y}\right)$$

7 (a) What do you mean by compatibility equations? What is the necessity of compatibility equations? Write the compatibility equations in Cartesian co-ordinates.

(b) In planar problems, stress components are expressed in Cartesian co-ordinate system where as the location at which stress is considered is defined in polar co-ordinates. Why such mixed approach adopted? Discuss.

8 (a) Derive the equations of equilibrium in polar co-ordinates for radial direction & tangential direction.

(b) The stress components at a point are $\sigma_x = -50, \sigma_y = 30, \sigma_z = 20. \tau_{xy} = -60, \tau_{yz} = 40, \tau_{xz} = 50\ MPa$. Determine the principle stresses and principle directions.

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