

B. Tech. Degree IV Semester Examination April 2013**ME 403 ADVANCED MECHANICS OF SOLIDS**
(2006 Scheme)

Time : 3 Hours

Maximum Marks : 100

PART A
(Answer ALL questions)

(8 x 5 = 40)

- I. (a) The state of stress at a point is characterized by the components
 $\sigma_x = 12.31$, $\sigma_y = 8.96$, $\sigma_z = 4.34$
 $\tau_{xy} = 4.20$, $\tau_{yz} = 5.27$, $\tau_{zx} = 0.84$
 Find the values of principal stresses.
- (b) The state of stress at a point is given by
 $\sigma_x = 100 \text{ MPa}$, $\sigma_y = -40 \text{ MPa}$, $\sigma_z = 80 \text{ MPa}$
 $\tau_{xy} = \tau_{yz} = \tau_{zx} = 0$.
 Determine the octahedral shear stress and its associated normal stress.
- (c) A steel rod having a cross sectional area of 5 sq.cm and a length of 25m is suspended vertically, fixed at the top. Find its extension under its own weight. E , for steel = $2.0 \times 10^6 \text{ kg/cm}^2$ and density is 7843 Kg/m^3 .
- (d) Write the expression for bending of beams and state the various assumptions in it.
- (e) Prove that the volumetric strain is equal to the sum of three principal strains.
- (f) The displacement held in micro units for a body is given by
 $u = (x^2 + 2y)i + (3 + 4z)j + (x^2 + y)k$
 Determine the principal strains at (3, -1, 2).
- (g) Write a note on centre of flexure.
- (h) Write a note on the applications of membrane analogy.

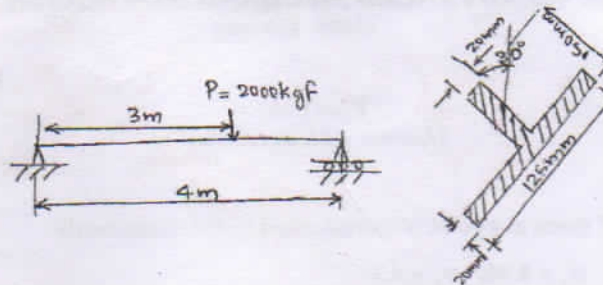
PART B

(4 x 15 = 60)

- II. (a) Derive the equations of equilibrium in Cartesian coordinates for the stress.
 (b) Write a note on boundary conditions of stress.
- OR**
- III. (a) Describe the various types of strain rosettes and their relative advantages. Discuss Murphy's construction and its uses.
 (b) In a rectangular rosette, the recorded strains are
 $\epsilon_{\sigma} = -110 \times 10^{-6}$
 $\epsilon_{45^\circ} = 60 \times 10^{-6}$
 $\epsilon_{90^\circ} = 110 \times 10^{-6}$
 Find principal strains graphically or otherwise.

(P.T.O)

- IV. (a) Derive an expression for plane strain in polar coordinates.
 (b) Determine the maximum absolute value of the normal stress due to bending and the position of the neutral axis in the dangerous section of the beam.



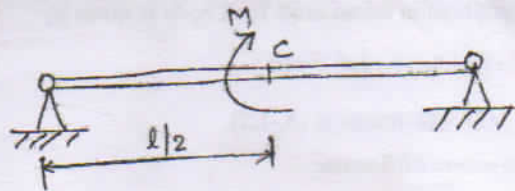
OR

- V. (a) Obtain an expression for stresses in rotating disks of uniform thickness.
 (b) A solid steel propeller shaft, 100cm in diameter, is rotating at a speed of 500rpm. If the shaft is constrained at its ends so that it cannot expand or contract longitudinally, calculate the longitudinal thrust over a cross section due to rotational stresses. Take $\nu = 0.3$, weight of steel = 0.0081 Kg/cm^2 .

- VI. (a) State and prove St. Venant's equations of compatibility.
 (b) Explain the theorem of virtual work.

OR

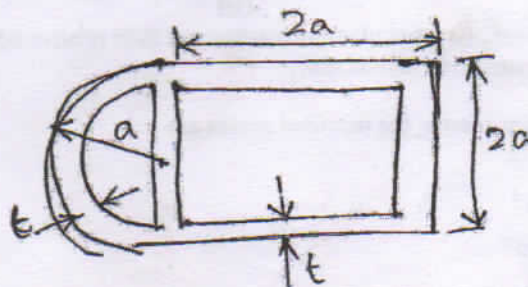
- VII. (a) Explain the second theorem of Castigliano and discuss its importance.
 (b) Determine the rotation of point C of the beam under the action of a couple M applied at its centre.



- VIII. (a) Derive an expression for torsion of elliptical bars.
 (b) Write a note on torsion of rolled sections

OR

- IX. (a) A thin walled box shown in the figure is subjected to a torque T. Determine the shear stresses in the walls and the angle of twist per unit length of the box.



- (b) Show that the twist per unit length for a thin walled tube is $\theta = \frac{q}{2AG} \oint \frac{ds}{t}$.