B.Tech. Degree IV Semester Supplementary Examination February 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) Define: (i) Stress at a point (ii) Strain at a point.

    (b) Write the compatibility equation and equilibrium equation for a 2-D problem.

    (c) Derive the equilibrium equations in polar coordinates.

    (d) List the advantages and applications of shrink fitted compound cylinders.

    (e) For stress and strain problems, values of invariants are independent of reference axes. Why?

    (f) State the theorems of Castigliano.

    (g) Prove that shear flow is constant for a thin walled tube subjected to torsion.

    (h) What is warping?

PART B
(4 x 15 = 60)

II. (a) Under what conditions, Mohr's circle will reduce to a point at the origin?   (5)

     (b) A stress matrix is given by $\tau_{ij} = \begin{bmatrix} 15 & 4 & 0 \\ A & 5 & 0 \\ B & C & 0 \end{bmatrix}$ kPa   (10)

         (i) What are the values of A, B and C?
         (ii) Find the values of principal stresses and maximum shear stress with the help of Mohr's circle.
         (iii) Verify the results using analytical solutions.

OR

III. Starting from the cautions for strain components, prove that   (15)

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right)(\sigma x + \sigma y) = \frac{-1}{1-\vartheta}\left(\frac{\partial X}{\partial x} + \frac{\partial Y}{\partial y} \right).$$

IV. Under generated loading conditions, radial displacement of a thick walled cylinder is given by: (15)

$U_r = C_1 r + C_2 / r$, where 'r' is any radius.

     (i) Obtain the expressions for σ_r and σ_θ

     (ii) Obtain the values for C_1 and C_2 when internal and external pressures are $-Pa$ and $-Pb$ respectively.

OR

V. (a) Write the equilibrium equations for a rotating disk.   (5)

    (b) Prove that $\varepsilon_\theta = \dfrac{Ur}{r}$ and $\varepsilon_r = \dfrac{\partial Ur}{\partial r}$.   (5)

    (c) Sketch the variations of σ_r and σ_θ for a cylinder subjected to internal pressure only.   (5)

(P.T.O.)

$$\begin{bmatrix} \sigma_1 & 0 & 0 \\ 0 & 0_2 & 0 \\ 0 & 0 & \sigma_3 \end{bmatrix}$$

VI. (a) At a pint P, stress matrix is $\tau_{ij} = \begin{bmatrix} 1 & 2 & 1 \\ 2 & -2 & -3 \\ 1 & -3 & 4 \end{bmatrix}$. Find the principal stresses and (10)

check for invariance.

(b) What is lame's ellipsoid? (5)

OR

VII. Prove that deflection at free end of a cantilever beam carrying a load 'P' there, (15)

is given by $\delta = \dfrac{PL^3}{3EI}$.(Neglect the effect of shear). Use the concept of strain

energy.

VIII. Starting from first principles, prove that warping function is harmonic (15)
(ie, it satisfies Laplace equation).

OR

IX. (a) Define shear centre. (5)

(b) Describe any one method of solving an unsymmetrical bending problem. (10)

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