B.Tech. Degree V Semester (Supplementary) Examination, July 2009

ME 503 ADVANCED MECHANICS OF SOLIDS
(2002 Scheme)

Time: 3 Hours Maximum Marks: 100

I a) Explain the method of construction of Mohr's Circle for plane stress case. Also indicate maximum shear stress and principal stresses. (10)

b) From compatability considerations, obtain compatability equations in 2-0 co-ordinates for stress terms. (10)

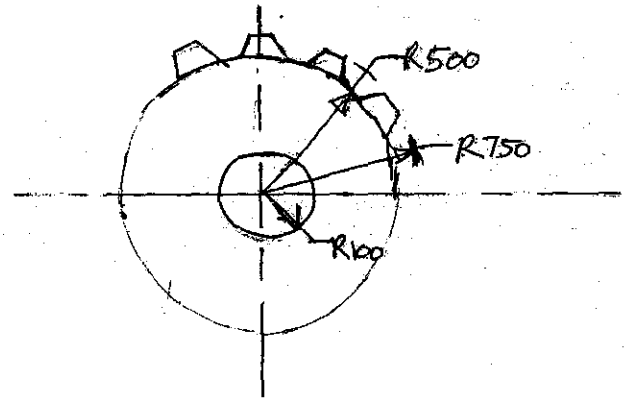
OR

II a) Explain St.Venant's principle in detail. (8)

b) Show that the Airy's stress function $\phi = A\left(xy^3 - \frac{3}{4}xyh^2 \right)$ represents stress distribution in a cantilever beam loaded at the free end with load P. Find the value of A if $\tau_{xy} = 0$ at $y = \pm\frac{h}{2}$ where $b \& h$ are width and depth respectively for the cantilever. (12)

III a) Obtain radial and tangential stresses in case of rotating discs. (8)

b) A steel rotor of an electrical machine having outer diameter 1500 mm and inner diameter 200mm, is provided with 200 mm deep trapezoidal slots axially around its outer periphery for accommodating the windings as shown in figure. Determine the maximum stresses induced in the rotor, if it rotates at 1500 rpm. Assume that the weight of the windings in the slot is the same as that of the material removed. The rotor density is 7800 kg/m^3 and Poisson's ratio as $\nu = 0.3$ (12)



OR

IV a) Derive an expression for shrink fit allowance when an internal pressure of P is applied. Also find the optimum value of the same. (20)

(Turn over)

V a) Explain Lami's stress ellipsoid. (8)

b) Given the state of stress at a point is,

$$\sigma_x = \sigma_y = \sigma_2 = \tau_{xy} = \tau_{y2} = \tau_{2x} = \rho .$$

Determine principal stresses and directions. (12)

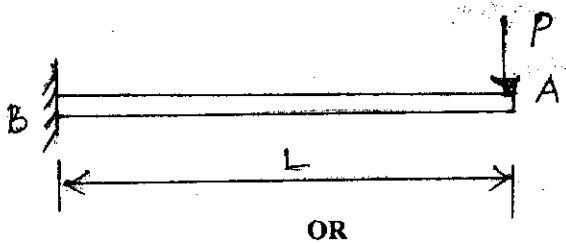
OR

VI a) Define octahedral stress. Derive an expression for the octahedral shear stress in terms of the principal stresses acting at the point. (10)

b) At a point in a stressed material, the principal stresses acting are given by $\sigma_1 = 120\,Pa$; $\sigma_2 = 60\,Pa$ and $\sigma_3 = 20\,Pa$. Find the normal and shear stress on plane whose normal is inclined at an angle of 40^0 to the σ_1 axis in the plane containing the σ_1 and σ_3 stresses and 50^0 to the σ_1 axis in the plane containing the $\sigma_1 + \sigma_2$ stresses. Find also the normal and shear stresses on the octahedral planes. (10)

VII a) Explain Castigliano's first theorem. (10)

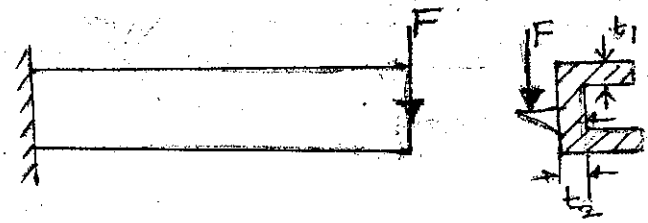
b) Determine the deflation at end A of the cantilever beam shown in figure. (10)



OR

VIII a) Explain the concept of shear center. Discuss its properties. (6)

b) Determine the shear stress distribution in a channel section of a cantilever beam subjected to a load F as shown, Also locate the shear center of the section. (14)



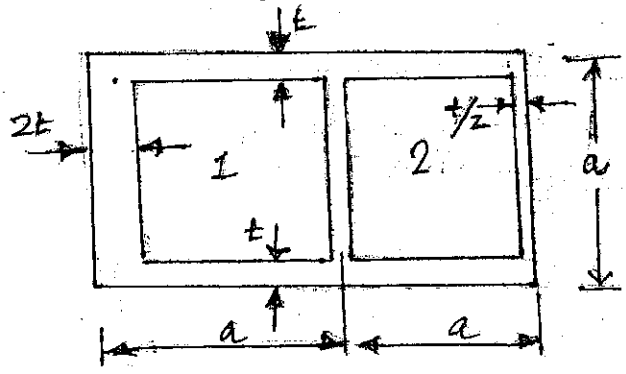
IX a) Derive the expression for stresses in a bar of elliptical cross-section subjected to a torque T; using a stress function $\phi = K\left[\frac{x^2}{a^2} + \frac{y^2}{b^2} - 1\right]$ where K is a constant.

Also determine the maximum resultant shear stress and its torsional rigidity. (20)

OR

X a) Explain Membrane Analogy. (10)

b) Figure shown below is a two cell tubular section whose wall thick nesses are as shown. If the member is subjected to a torque T, determine the shear flows and the angle of twist of the member per unit length. (10)



****