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10CV661

Sixth Semester B.E. Degree Examination, June/July 2018
Theory of Elasticity

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. List the assumptions made in classical theories of elasticity. Hence define 'stress at a point'. **(10 Marks)**

b. Define : i) Normal strain ii) Shear strain. **(05 Marks)**

c. State St.Venant's principle. **(05 Marks)**

2 a. Derive differential equations of equilibrium for a body subjected to 3-dimensaionl body forces. **(06 Marks)**

b. Derive the expression $\nabla^4\phi + (1-\mu)\nabla^2\rho = 0$ from the biharmonic equation. **(08 Marks)**

c. Prove that the function $\phi = Ax^3$ satisfies the stress function and examine the stress distribution represented by it. **(06 Marks)**

3 a. Obtain the compatibility equation for plane stress problems in Cartesian form. **(10 Marks)**

b. The state of stress is given by the following matrix. Determine the principle stresses and principle directions.

$$\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix}$$ **(10 Marks)**

4 a. Obtain the expression for strain components is the form of compatibility equation, for two dimensional problems. **(08 Marks)**

b. For the cantilever beam shown in Fig Q4(a), draw the variation of bending stress and shear stress using the function $\sigma_x = \frac{\partial^2\phi}{\partial y^2} = C_1xy$.

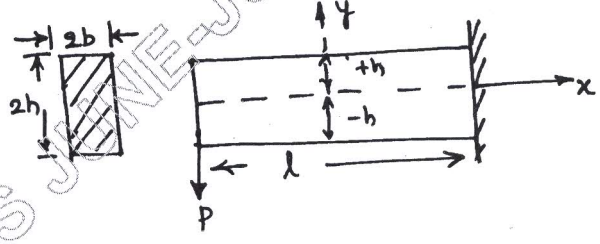

Fig Q4(a) **(12 Marks)**

PART – B

5 a. Derive 2-dimensaionl equation of equilibrium is polar co-ordinates. **(10 Marks)**

b. Investigate whether the following stress functions are possible

i) $\phi = r\,\text{Cos}\,\theta$ ii) $\phi = \frac{p}{\pi}.r\theta\text{Cos}\theta$ **(10 Marks)**

6 a. Derive the expression for stresses for the rotating disc assuming the stress distribution is symmetrical with respect to axis of rotation consider the disc is a solid one. **(15 Marks)**

b. The following are principle stresses at a point in a stresses material. Taking E = 210kN and $\mu = 0.3$, calculate volumetric strain and Lame's constant
$\sigma_x = 200\ N/mm^2$, $\sigma_y = 150N/mm^2$, $\sigma_z = 120N/mm^2$. **(05 Marks)**

7 Derive the effect of circular hole on the stress distribution of a rectangular plate subjected to tensile stress in x-axis only. Hence evaluate stress concentration factor. **(20 Marks)**

8 a. Determine the torsion and maximum shear stress for an elliptical bar using Laplace equation $\psi = Axy$. **(10 Marks)**

b. A hollow aluminium tube of rectangular cross – section is shown in Fig Q8 (b). It is subjected to a torque of 56,500 N-m along its longitudinal axis. Determine the shearing stresses and angle of twist. Take $G = 27.6 \times 10^9\ N/m^2$.

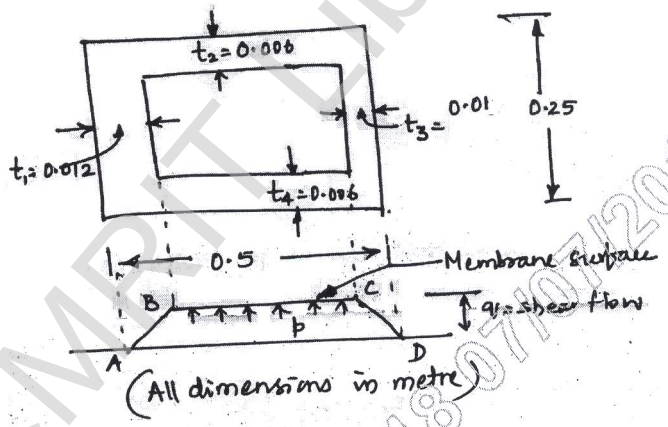

Fig Q8(b) **(10 Marks)**

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