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10CV661

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Theory of Elasticity

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Obtain strain displacement relationship in Cartesian co-ordinate system. **(06 Marks)**

b. Calculate the strains and stresses for the displacement fields in plane stress idealization shown below given E = 200GPa and $\mu = 0.25$ at a point (2, 4).
$U = (4x^4 + 2x^2y^2 + x + 3) \times 10^{-3}$ and $V = (y^4 + 3x^2y + 1) \times 10^{-3}$. **(14 Marks)**

2 a. Derive the compatibility equation in terms of stress components for plane strain problems. **(10 Marks)**

b. Check whether $\phi = =\frac{F}{d^3} xy^2 (3d - 2y)$ represents a stress function and find the stress components. **(10 Marks)**

3 a. Explain what is meant by strain rosette and how it can be used to determine the principal stress at point. **(06 Marks)**

b. The strain at a point measured are :
$\epsilon_{0^0} = 2 \times 10^{-3}$, $\epsilon_{45^0} = 1.5 \times 10^{-3}$ and $\epsilon_{90^0} = 1.0 \times 10^{-3}$ by a rectangular strain rosette respectively. Determine i) Principal strain ii) Principal stress and iii) Maximum shear. Take E = 200GPa and $\mu = 0.25$. **(14 Marks)**

4 a. Briefly explain St. Venant's principle. **(03 Marks)**

b. Investigate what problem of plane stress is solved by the stress function.
$\phi = \frac{3F}{4C}\left(xy - \frac{xy^3}{3C^2}\right) + \frac{PY^2}{2}$ in the absence of body forces and applied to the region $y = \pm C$, $x = 0$ and on the +ve x. **(17 Marks)**

PART – B

5 a. Derive the differential equations of equilibrium in polar co-ordinate system. **(10 Marks)**

b. Determine σ_r, σ_θ , and $\tau_{r\theta}$ for the stress function $\phi = -\frac{P}{\pi} r\theta \sin\theta$. Find the values of stress components at P = 10MPa , r = 2 and $\theta = 45^0$ for axi symmetric case. **(10 Marks)**

6 a. Derive the expression for stress function in case of axi symmetric stress distribution. Hence write down the expressions for stress components. **(08 Marks)**

b. Obtain the expressions for stress components in a thin solid rotating disc and show the distribution of stresses. **(12 Marks)**

7 Obtain the stress concentration factor for a plate containing a small circular hole under the action of uniform tensile stress along its longitudinal axis. **(20 Marks)**

8 a. For torsion problems show that the stress function must satisfy $\nabla^2 \phi = -2G\theta$. With usual notations. **(08 Marks)**

b. Obtain the expression for maximum shear stress in a shaft of elliptical cross section having major and minor axis 2a and 2b respectively. **(12 Marks)**

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