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10CV661

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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. State and explain Saint Venant's principle. **(04 Marks)**

b. For an homogeneous and elastic body with Young's modulus E = 200 GPa and Poisson's ratio $\mu = 0.3$ in subjected to a displacement given by :

$u = (4x^2 + 3y^2 + 4z^3) \times 10^{-3}$

$v = (3x^2 + 6y^3 + 4z^2) \times 10^{-3}$

$w = (4x^3 + 8y^2 + 4z^2) \times 10^{-3}$

c. Determine the strain components at the point (2, 3, –4) and the corresponding stress components. **(16 Marks)**

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

b. The following are the state of stress at a point $\sigma_x = y^2 + k(x^2 - y^2)$ and $\sigma_y = x^2 + k(y^2 - x^2)$, determine expression for τ_{xy} in order that the stresses distribution is in equilibrium in the absence of body forces. **(10 Marks)**

3 a. Distinguish between plane stress and lane strain problems, with an example for each. **(04 Marks)**

b. The strain components at a point are given as $\varepsilon_x = 2 \times 10^{-6}$; $\varepsilon_y = 10 \times 10^{-6}$; $\gamma_{xy} = 4 \times 10^{-6}$. Draw Mohr's circle of strains and hence find principal strains, maximum shear strain and strain components on a plane inclined at 45° to horizontal. Use suitable scale and sign convention. **(16 Marks)**

4 Determine the value of constant 'C' in the stress function :

$$\phi = C\left[\left(x^2 + y^2\right)\left(\alpha - \tan^{-1}\frac{y}{x}\right) + xy - x^2 \tan\alpha\right]$$

Required to satisfy the condition on upper and lower edges of a triangular plate shown in Fig. Q4. Evaluate the stress components σ_x and τ_{xy} for a vertical section 'mn'. Draw the stress distribution curve for the case $\alpha = 20°$ and compare the same given by elementary beam theory. **(20 Marks)**

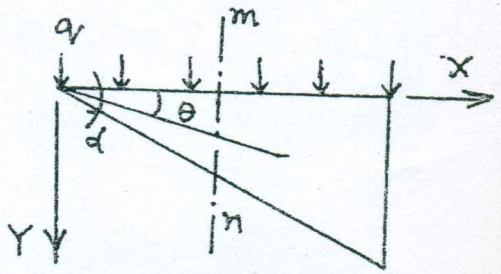

Fig.Q4

PART – B

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

b. Determine the 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 = 10 MPa, r = 2 and $\theta = 45°$ for axy symmetric case. **(10 Marks)**

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

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

7 Obtain the expressions for stress components in a thin plate with a central circular hole subjected to tensile stress along its longitudinal axis. Hence obtain the stress concentration factor. **(20 Marks)**

8 a. Derive the differential equation for the torsion problem in the form :

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)\phi = -2G\theta$$

With usual notations. **(08 Marks)**

b. Find the stresses at any point of a shaft of elliptical cross section, whose major and minor axes are 2a and 2b respectively. **(12 Marks)**

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