USN

10CV661

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Theory of Elasticity

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain:
i) Stress at a point
ii) Strain at a point. **(10 Marks)**

b. Explain the assumptions made in theory of elasticity, and also its applications. **(10 Marks)**

2 a. What is Airy's stress function? **(05 Marks)**

b. For a plane stress case, derive the compatibility equation in terms of strains and stresses. **(15 Marks)**

3 a. Define the following with sketches and suitable examples:
i) Plane stress problems.
ii) Plane strain problems. **(10 Marks)**

b. By means of a strain rosette, the following strains, were recorded during the test on a structural member.

$\epsilon_{\phi} = 2\times10^{-3}$, $\epsilon_{(\alpha+\phi)} = 1.35\times10^{-3}$, $\epsilon_{(\alpha+\beta+\phi)} = 0.95\times10^{-3}$.

Determine : i) Magnitude of principal strains and
ii) Orientation of principal planes.

Given that: $\phi = 0^{0}$, $\alpha = \beta = 45^{0}$, $\mu = 0.33$, E = 210 GPa **(10 Marks)**

4 Investigate what problem of plane stress is satisfied by the stress function,

$$\phi = \frac{3F}{4h}\left[xy - \frac{xy^3}{3h^2}\right] + \frac{P}{2}y^2$$

applied to the region included in y = 0, y = h, x = 0, on the side x positive. **(20 Marks)**

PART – B

5 a. Derive the compatibility equation in polar co-ordinate system. **(12 Marks)**

b. For the stress function, $\phi = \frac{P}{\pi} r\theta \sin\theta$. Determine the stress components σ_r, σ_θ and $\tau_{r\theta}$. **(08 Marks)**

6 Prove that $(\sigma_r)_{max} = (\sigma_\theta)_{max} = \left(\frac{3+\mu}{8}\right)e\omega^2 b^2$ in the case of rotating circular disc of uniform thickness. **(20 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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