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10CV661

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Theory of Elasticity

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
2. Missing data may be suitably assumed.

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. 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. If E is replaced by $\frac{E_1}{1-\mu_1^2}$ and μ by $\frac{\mu_1}{1-\mu_1}$ in plane stress constitutive relations, prove that

$$\nabla^2(\sigma_x + \sigma_y) = -\frac{1}{(1-\mu_1)}\left(\frac{\partial X}{\partial x} + \frac{\partial Y}{\partial y}\right).$$ **(10 Marks)**

b. Determine the principal strains and their directions for an equiangular strain rosette.
Given : $\epsilon_0^0 = 550 \times 10^{-6}$ $\epsilon_{60^0} = -100 \times 10^{-6}$ $\epsilon_{120^0} = 150 \times 10^{-6}$. **(10 Marks)**
Also determine the principal stresses given $\mu = 0.3$ and E = 200GPa.

4 Obtain an expression for σ_x for a simply supported rectangular beam of length '2L', width = unity and depth = '2h' is subjected to uniformly distributed load of intensity 'q' units per run over its entire length as shown in Fig. Q4. **(20 Marks)**

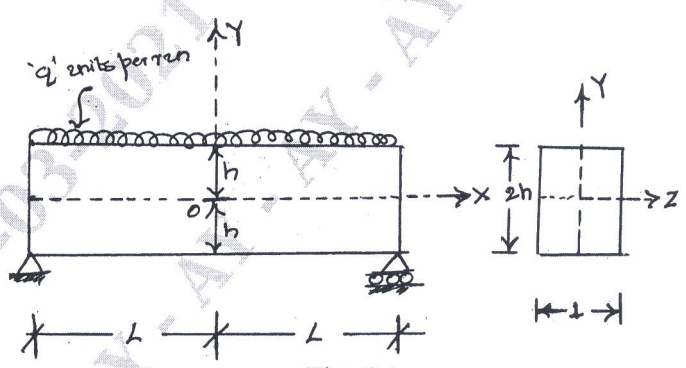

Fig. Q4

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. Prove that for a solid rotating disk, the maximum stresses are given by

$(\sigma_r)_{max} = (\sigma_\theta)_{max} = \left(\frac{3+\mu}{8}\right)\rho\, w^2 b^2$. **(10 Marks)**

b. Also prove that for a hollow disk of inner radius "a" and outer radius "b",

$(\sigma_r)_{max} = \left(\frac{3+\mu}{8}\right)\rho\, w^2\, (b-a)^2$. Show that $(\sigma_\theta)_{max} > (\sigma_r)_{max}$. **(10 Marks)**

7 Discuss the effect of circular hole on the stress distribution in a rectangular plate subjected to tensile stress in X-direction. Hence evaluate the stress concentration factor. **(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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