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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Sixth Semester, B.E. - Mechanical Engineering

Semester End Examination; June/July - 2015

Theory of Elasticity

Time: 3 hrs *Max. Marks: 100*

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

PART - A

1 a. For the given state of stress, determine the principal stresses and their directions. 8

$$\sigma_y = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

b. Explain the significance of Equilibrium equations. Derive the force and moment equilibrium equations for 2D state of stress. 12

2 a. Explain the significance of compatibility equations and derive one equation for 3D from each set. 12

b. The state of strain at a point is given by $\in_x$ = 0.0015, $\in_y$ = - 0.0025, $\in_z$ = γ_{xy} = 0, γ_{xz} = -0.004, γ_{yz} = 0.0015. Determine the stress tensor at the point and also Lame's constants. E = 208 GPa and γ = 0.28 8

3 a. Show that $\sigma_{xx} = (-Pxy)/I, \sigma_{yy} = 0, \tau_{xy} = (-P/2I)(d^2/4 - y^2)$ are expressions for stress components in solving a problem for a narrow cantilever beam under an edge load P, span L and of rectangular cross section. 15

b. Check whether the following function is a stress function and obtain expression for stresses. σ_{xx}, σ_{yy} & τ_{xy}. $\phi = 3F\left(xy - xy^3/3c^2\right)/4c + py^2/2$ 5

4 a. Derive expression for radial and tangential stresses for a thick cylinder subjected to internal and external pressure. 12

b. A thick cylinder of inner diameter 140 mm and outer diameter 200 mm is subjected to an internal pressure of 40 MPa and external of 24 MPa. Determine maximum shear stress. 8

PART - B

5 a. Derive expression for radial and tangential stresses in a rotating solid disk of uniform thickness. 12

b. A solid disc of uniform thickness and having diameter of 400 mm rotates at 7500 rpm. Determine the maximum values of radial, hoop and shear stresses and there location. ρ = 7500 kg/m^3 8

Contd…2

6	a.	Show that the warping function Φ for the torsion of prismatic bar of solid section satisfies the Laplacian.	8
	b.	A shaft consisting of prismatic bar having an elliptical cross section with a major axis '2a' and minor axis '2b' is subjected to a twisting moment Γ. Find the shearing stresses in the shaft in the fibres at the ends of major and minor axes of the cross section.	12
7	a.	Discuss Thermoelastic stress strain relations.	8
	b.	Derive the expressions for radial and tangential stresses in a thin solid circular disk of uniform thickness and subjected to temperature distribution T which is a function of radius only.	12
8	a.	Prove that an elastic body for which displacements are specified at some points and forces at others, will have a unique equilibrium configuration.	8
	b.	State Saint Venants principle. Explain its importance in theory of elasticity.	5
	c.	State and prove Principle of super position.	7

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