15CV554

Visvesvaraya Technological University, Belagavi

MODEL QUESTION PAPER

5th Semester, B.E (CBCS) CV

Course: 15CV554 – Theory of Elasticity

Time: 3 Hours **Max Marks: 80**

Note: (i) Answer Five full questions selecting any one full question from each Module.
(ii) Question on a topic of a Module may appear in either its 1st or 2nd question.

<table>
<tr><td colspan="4">Module 1</td></tr>
<tr><td rowspan="2">1</td><td>(a)</td><td>Define body force and surface force</td><td>3</td></tr>
<tr><td>(b)</td><td>Derive the equations of equilibrium in three dimensions</td><td>5</td></tr>
<tr><td></td><td>(c)</td><td>The state of stress at a point is given by following
$\begin{pmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{pmatrix}$ Mpa
Determine principal stress and principle direction.</td><td>8</td></tr>
<tr><td colspan="4">OR</td></tr>
<tr><td rowspan="3">2</td><td>(a)</td><td>What are the assumptions made in theory of Elasticity</td><td>4</td></tr>
<tr><td>(b)</td><td>Derive the equation of compatibility for strain in three dimensions</td><td>4</td></tr>
<tr><td>(c)</td><td>The following strains have been measured at a point on the unloaded surface of a body
<table><tr><td>Direction</td><td>Angle θ</td><td>Strain</td></tr><tr><td>1</td><td>0</td><td>0.002</td></tr><tr><td>2</td><td>120</td><td>0.002</td></tr><tr><td>3</td><td>240</td><td>-0.001</td></tr></table>Determine the principal strain and the direction of principal planes?</td><td>8</td></tr>
<tr><td colspan="4">Module 2</td></tr>
<tr><td rowspan="3">3</td><td>(a)</td><td>With examples explain Plane stress and Plane strain problems.</td><td>4</td></tr>
<tr><td>(b)</td><td>Write a short note on i) Generalized Hook’s law ii) Membrane analogy</td><td>4</td></tr>
<tr><td>(b)</td><td>Show that $\phi = \frac{q}{8c^3} x^2(y^3 - 3c^2y + 2c^3) - \frac{1}{5} y^3 (y^2 - 2c^2)$
Is a stress function and find what problem it can solve, the when applied to region included y = ±c, x = o on the Side × Positive.</td><td>8</td></tr>
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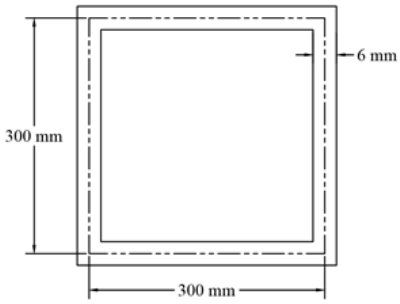
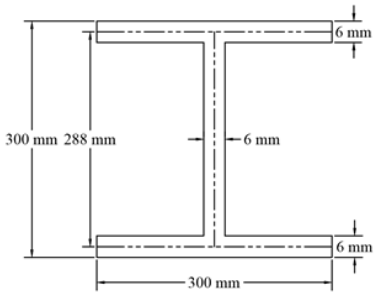
		OR	
4	(a)	Write a short note on i) Uniqueness theorem ii) St.Venant's Principle .	4
	(b)	Explain the Airy's stress function Derive the biharmonic stress function in Cartesian coordinate for a two dimensional stress state	5
	(c)	Given the stress function $\phi = -\frac{Fxy^2}{h^3}(3h - 2y)$. Determine the stress components and sketch the variations in a region included y=0 ,y=h, x=0 on the side X positive.	7
		Module 3	
5	(a)	A rectangular cantilever concrete beam of depth d and width b is having span L measured from the free end. It carries a vertical downward load of P at free end. Derive the expressions for stresses at any point using stress function approach	9
	(b)	Given the following stress function $\phi = \frac{Pr\theta\cos\theta}{\Pi^3}$ determine the stress component σ_r, σ_Θ and $\tau_{r\theta}$	7
		OR	
6	(a)	Show that for simply supported beam having length 2L ,depth 2H and unit width ,loaded by a concentrated load at the mid span the stress function satisfying the loading condition is $\phi = bxy^3 + cxy$. Treat the concentrated load as a shear stress suitably distributed to 6 Suit the function, so that $\int_{-h}^{+h} \tau_{xy} = \frac{-w}{2}$ on each half length of beam. Also find stresses in the beam.	8
	(b)	Derive the equations of equilibrium for a two dimensional stress system in cylindrical coordinates.	8
		Module 4	
7	(a)	Derive the expressions for radial and tangential stress components in rotating disc for i) Solid disc ii) Solid disc with hole	8
	(b)	Determine the stress in radial and tangential direction for a stress function $\phi = A\log r + Br^2\log r + Cr^2 + D$ taken for hollow cylinder submitted to uniform pressure	8
		OR	
8	(a)	Discuss the effect of a circular hole on the stress distribution in an infinite plate subjected to tensile stress in X direction only and hence evaluate the stress concentration factor	9
	(b)	A steel cylinder which has inside diameter of 1m is subjected to an internal pressure of 8 MPa . calculate the wall thickness if the maximum shearing stress is not exceeds 35 MPa	7

Module 5			
9	(a)	Discuss the torsion of solid circular cross section shaft using a warping function ϕ	3
	(b)	Derive the equations of stresses for rotating disc of uniform thickness	6
	(c)	A Closed square section is subjected to torque of 600 N –m. Find the Maximum shear stress and twist unit length. Given G = 80000 N/mm^2 and Length = 1200mm 	7
OR			
10	(a)	Prove that the stress function in the torsional problem is equal to the deflection of the membrane	3
	(b)	Explain membrane analogy as applied to torsional members	6
	(c)	Calculate the maximum shear stress and the angle of twist. Twisting moment =615 N – m, G=80000 MN/m^2. 	7