R09

Code No: C2002

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I - Semester Examinations, March/April 2011
THEORY OF ELASTICITY AND PLASTICITY
(STRUCTURAL ENGINEERING)

Time: 3hours **Max. Marks: 60**

Answer any five questions
All questions carry equal marks
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1. (a) For a plane stress case, derive the compatibility equation in terms of strains and stress when the body forces are present.
(b) The stress distribution is given by
$\sigma_x = -kxy^2 + ax^3$
$\sigma_y = -1.5bxy^2$
$\tau_{xy} = -by^3 - c\,x^2y$
Determine the constants a, b, c and k if the body forces are zero and k is an unknown force. [12]

2. (a) Evaluate the Lame's constants for the material whose $E=2(10)^5$ N/mm^2 and Poisson's ratio $\mu = 0.3$
(b) Determine the principal stresses and any one of the principal directions. The readings are
$\varepsilon_0=300(10)^{-6}$, $\varepsilon_{45} = -200(10)^{-6}$, $\varepsilon_{90} = -150(10)^{-6}$, E = 200GPa and $\mu = 0.3$. [12]

3. (a) Derive the compatibility equation of the form
$$\nabla^2(\sigma_x + \sigma_y) = 0$$
(b) Check whether the following are stress functions.
(i) $\emptyset = \frac{M}{y}\left(y\ tan^{-1}\left(\frac{x}{y}\right)\right)$
(ii) $\emptyset = \frac{q}{8c^3}\left[x^2(y^3 - 3c^2y + 2c^3) - \frac{y^5}{5}(y^2 - 2c^2)\right]$. [12]

4. (a) Discuss what problems of plane stress can be solved by using a third degree polynomial?
(b) Mention the limitations of polynomial solutions?
(c) A cantilever beam has a width of unity, length l and depth h. It is loaded at the free end by a force P. Derive the expression for vertical deflection. [12]

5. (a) Derive the equations of equilibrium of a two dimensional stress system in polar coordinates?
(b) Is the following a stress function
$\emptyset = -\frac{P}{\pi} r\theta \sin\theta$. If so, check the validity of equations of equilibrium. [12]

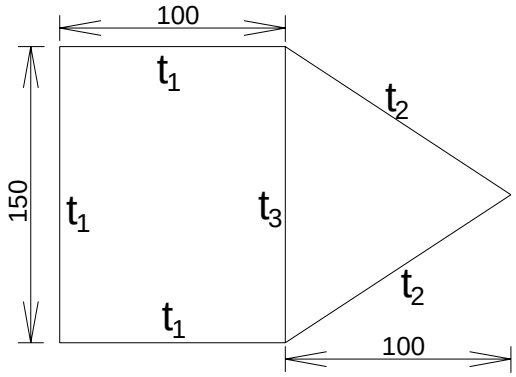
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6. (a) Derive the equilibrium equation and boundary conditions of a bar subjected to a pure torsion as

$$\nabla^2\Psi = 0$$

$$\left(\frac{\partial\Psi}{\partial x} - y\right)l + \left(\frac{\partial\Psi}{\partial y} + x\right)m = 0$$

(b) A thin walled tube has the cross section shown in Fig. Determine the shear stress developed in the walls. Applied torque =1500Nm. G = 80000MN/m^2, t_1 = 5mm, t_2 = 3mm and t_3 = 3mm. [12]



7. (a) Discuss the yield criteria and flow rules for perfectly plastic and strain hardening materials.
(b) The load on the bolt consists of an axial pull of 10kN together with a direct shear of 5kN. Estimate the diameter of the bolt according to various theories of failure. E = 200kN/mm^2; μ = 0.3, factor of safety = 3, and the elastic limit in simple tension = 270 N/mm^2. [12]

8. Write short notes on:
   (a) Generalized Hooke's law.
   (b) Tresca criteria.
   (c) Principle of superposition.
   (d) Membrane Analogy.
   (e) Polynomial solution of two dimensional problems. [12]

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