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Reg. No. : .....

Name : .....

First Semester M.Tech. Degree Examination, June 2009
Branch : Civil (2008 Scheme)
Structural Engineering and Construction Management (Common)
CSC 1005 : THEORY OF ELASTICITY

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **any five** questions.*
*2) **All** questions carry **equal** marks.*

1. a) What is generalized Hooke's law ? Esatblish the stress-strain relationship for isotropic materials and hence the relationship between the elastic constants.

   b) The state of stress at a point with respect to the xyz system is

$$\begin{pmatrix} 300 & 200 & -200 \\ 200 & 0 & -100 \\ -200 & -100 & -200 \end{pmatrix} \text{MPa}$$

   Determine the stress tensor relative to the $x'y'z'$ coordinate system obtained by a rotation through 30° about the z-axis.

2. a) Derive the compatibility conditions for 3D in terms of stress.

   b) Show that $\Phi = \frac{q}{8c^3}\left\{x^2\left(y^3 - 3c^2y + 2c^3\right) - \frac{1}{5}y^3\left(y^2 - 2c^2\right)\right\}$ is an acceptable stress function and hence find the stress field it represents.

3. a) What is stress-function in the solution of two dimensional problems in elasticity ? Obtain the biharmonic equation in polar co-ordinates from the Cartesian Co-ordinate system.

   b) Derive the equilibrium equations in polar Co-ordinate system.

P.T.O.

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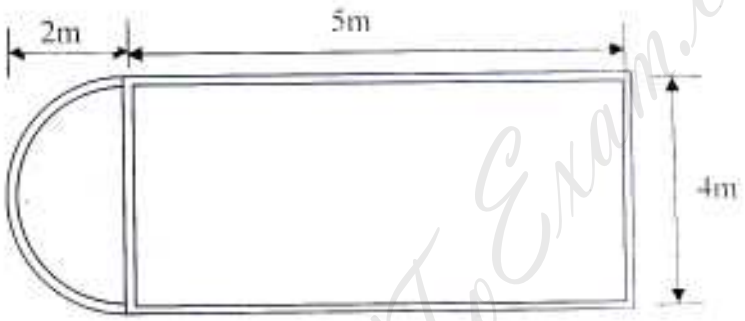
4. a) Derive the stress components of a rotating circular disc of uniform thickness with central hole of radius 'a'.

   b) Determine the stress distribution in a curved bar with constant narrow rectangular cross-section in pure bending.

5. a) Analyse the torsion of an equilateral triangular bar.

   b) Find the shear stresses and the angle of twist in the multi-cellular structure, as shown in figure, subjected to a torque of 400 kNm. Wall thickness of the structure is uniform and is equal to 15 mm. Take G= 31.1 GPa.



6. a) Discuss St. Venant's semi-inverse method for torsion of general prismatic bars. Also obtain the relation between torsion, angle of twist and torsional rigidity.

   b) Derive the expression for 'τ_{max}' and 'θ' for thin rectangular section subjected to a torque '*T*'.

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