Roll No .....

MVSE - 102

M.E./M.Tech. I Semester

Examination, December 2015

Strength of Material and Theory of Elasticity

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.
iii) Any data missing but essential may be assumed suitably and should be stated.

1. a) Define homogeneous, isotropic and anisotropic materials.
   b) Derive the differential equations of equilibrium in 3D, in Cartesian system of co-ordinates.

2. The state of stress at a point is given as (all in MPa):
   $\sigma_{xx}=90, \sigma_{yy}=85, \sigma_{zz}=-40, \tau_{xy}=45, \tau_{yz}=58, \tau_{xz}=34$
   Find the resultant stress on a plane whose normal has the direction cosines 1=0.62 and m=0.37.

3. a) Show that Airy stress function $\varphi = 2x^4+12x^2y^2 - 6y^4$ satisfies the Bi-harmonic equation. Also, determine the stress components assuming plane strain condition.
   b) Obtain an appropriate stress function for the following cases:
      i) Uniaxial state of stress
      ii) Pure shear

4. a) Show by considering the equilibrium of the whole bar that when all stress components vanish except τ_{xz}, τ_{yz} the loading must consist of torsional couples only.
   b) Discuss torsional problem for thin tubes using the membrane analogy.

5. a) For the displacement field given as:
   $u=3xy^2$, $v=2xz$, $w=z^2-xy$
   Check whether the compatibility condition is satisfied or not.
   b) Explain the significance of strain compatibility equation.

6. a) Differentiate between plane stress and plane strain problems. Give examples to illustrate your answer.
   b) Derive elastic constitutive matrix for both plane stress and plane strain cases.

7. a) Discuss strain components in Polar co-ordinate system.
   b) An open ended thick wall cylinder (Internal radius = r_1, external radius = r_2) is subjected to both internal and external pressure p_1 and p_2 respectively. Compute tangential and radial stresses.

8. Write short notes on any Four:
   a) Homogeneous and Isotropic material
   b) Generalized Hook's law
   c) Stress Invariants
   d) Torsion of rectangular bars
   e) Torsional buckling

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