 Roll No .....

MVSE - 102

M.E./M. Tech., I Semester

Examination, June 2014

Strength of Material And Elastic Theory

Time : Three Hours *Max. Marks : 70*

Note: i) Solve any five questions.
ii) All questions carry equal marks.
iii) Data missing and found necessary may be suitably assumed.

1. Show that the following quantities are INVARIANTS:
   a) $\left[\sigma_x \sigma_y + \sigma_y \sigma_z + \sigma_z \sigma_x - \tau_{xy}^2 - \tau_{yz}^2 - \tau_{xz}^2\right]$
   b) $\left[\sigma_x \sigma_y \sigma_z + 2\tau_{xy} \tau_{yz} \tau_{xz} - \sigma_x \tau_{yz}^2 - \sigma_y \tau_{xz}^2 - \sigma_z \tau_{xy}^2\right]$

2. a) Derive equilibrium equation in 3-D Cartesian coordinate system.
   b) For the given state of stress at point

$$\sigma = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & p \end{bmatrix}$$

Obtain 'p' such that the resultant stress on an oblique plane disappears. Also get the direction cosines of the planes.

3. a) How do you obtain solution of elasticity problems by polynomials? Explain it.

   b) Explain saint Venant's principle. Determine the stresses for bending of a cantilever loaded at the end.

4. a) Derive the equation of equilibrium of stresses in a 2-D field in polar coordinates.
   b) The radial and the transverse displacement components at point in polar coordinate are given as $(r \cos\theta + r^3)$ and $(r^2 \sin\theta - r)$, obtain the strain components at a point $(0.5, 60°)$

5. A tube whose external and internal diameters are 45 cms. and 30 cms. respectively, has another tube 8 cms. thick shrimll onto it. The internal diameter of this outer tube is machined to be 1mm less than the external diameter of the inner tube. If the tubes are made of steel with $E = 2\times10^5 N/mm^2$. determine the expressions for the stresses developed in the inner tube.

6. Derive expressions for deflection, slope and bending moment for a uniform infinite beam resting on an elastic foundation and subject to uniformly distributed load of 'q'.

7. a) Derive the six equation of compatibility.
   b) Solve the torsional problem of rolled profile section.

8. Write short notes on the following:
   i) Anisotropic materials
   ii) Solution of two dimensional problem in Fourier series
   iii) Torsion of thin tubes
   iv) Elastic constitutive relations

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