Total No. of Questions :8] *[Total No. of Printed Pages :2*

Roll No .....

MVSE-102

M.E./M.Tech. I Semester

Examination, December 2016

Strength of Material and Elastic Theory

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.

1. a) Derive equilibrium equations of Theory of elasticity.
   b) Derive equilibrium equation in 3-D Cartesian co-ordinate system.

2. a) Show the following quantities are INVARIANTS.

$$\left[\sigma_x\sigma_y + \sigma_y\sigma_z + \sigma_z\sigma_x - \tau^2_{xy} - \tau^2_{yz} - \tau^2_{zx}\right]$$

   b) Derive equilibrium equation in 3-D Cartesian co-ordinate system.

3. Given state of stress at a point ;

$$\sigma = \begin{bmatrix} XY^2 & XY(3+Z) & YZ^2 \\ XY(3+Z) & Y^2(3X - Z^2) & X^2Y^2Z^2 \\ YZ^2 & X^2Y^2Z^2 & YZ^3 + Y \end{bmatrix}$$

Obtain body force distribution at [1,1,1] so that the continuum is in equilibrium

4. a) What is the effect of a circular hole on stress distribution on a plate subjected to tension of magnitude "S" in x-direction? Using Saint Venant's principle show that change in stress distribution is negligible at distances which are large compared to radius of hole.
   b) Derive expression for shear stress, angle of twist and twisting moment for a rectangular section.

5. a) What do you understand by membrane analog? How is it useful in torsional analysis?
   b) Why do we use polar co-ordinate system? Derive equations of equilibrium and compatibility in polar co-ordinate system.

6. The radial and transverse displacement components at point in polar co-ordinate are given as ($r\cos\theta - r^3$) and ($r^2\sin\theta - r$) obtain the strain components at a point (0.5, 60°)

7. a) Explain Torsional flexural buckling and torsional buckling.
   b) Discuss about pure bending of curved bar.

8. Find the expression for the body forces distribution necessary to satisfy the equation of equilibrium considering the following stress function :

$\sigma_x = 80x^3 + y$
$\sigma_y = 100\,(x^3 + 10)$
$\sigma_z = 10\,(9y^2 + 10x^3)$
$\tau_{xy} = 100\,(1 + y^2)$
$\tau_{yz} = 0$
$\tau_{zx} = x\,(z^3 + 100\,xy)$

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