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Total No. of Questions : 8] *[Total No. of Printed Pages : 3*

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MVSE - 102

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

Examination, June 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.
iii) Any data missing but essential may be assumed suitably and should be stated.

1. a) The state of stress at a point is given as (all in MPa):

$\sigma_{xx} = 40, \sigma_{yy} = -40, \sigma_{zz} = 60, \tau_{xy} = 20, \tau_{yz} = 25, \tau_{xz} = 15.$

Find the resultant stress on an oblique plane equally inclined to the three axes Also, find the normal and the shear stress components.

b) Discuss Generalized Hook's law.

2. a) The stress tensor at a point is given by:

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

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

b) What do you mean by stress invariants?

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3. a) Derive the equations of equilibrium of stresses in Polar co-ordinate system.

   b) An infinitely large thin plate with a small circular hole is subjected to bi-axial state of equal tensile stress. Choose an appropriate stress function and prove that stress distribution at the edge of hole in uniform.

4. a) Differentiate between plane stress and plane strain problems.

   b) Show that for an elastic continuum with constant body forces, the stress compatibility equation under the plane stress condition may be written as:

$$\nabla^2 (\sigma_{xx} + \sigma_{yy}) = 0$$

5. a) Differentiate between Orthotropic and Isotropic elastic material.

   b) Evaluate the principal stress values and the orientation of the major principal plane for the state of stress given below:

$$\sigma = \begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

6. a) Show that the stress distribution follows a linear law in the case of a torsion of a bar of narrow rectangular cross-section.

   b) Discuss torsion of Rolled profile sections.

7. a) Discuss the two different methods which can be formulated to solve elasticity problems.

   b) For a cantilever beam subjected to a point load P at the free end, the stress solution is given as figure 1.

$\sigma_{xx} = -(P/I)\, xy$; $\sigma_{yy} = 0$; $\sigma_{xy} = -(P/2I)[(d^2/4) - y^2]$

Obtain the expression for the maximum transverse deflection.

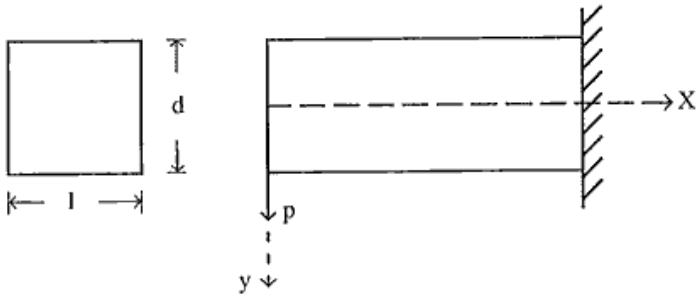

Fig. 1

8. Write short notes on any four:

   a) Boundary conditions

   b) Stress function

   c) Membrane analogy

   d) Solution of torsional problems

   e) Strain components in polar co-ordinates

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