(Pages : 3)

9110

Reg. No. : ....

Name : ....

First Semester M.Tech. Degree Examination, February 2015
(2013 Scheme)
Civil Engineering
Streams : Structural Engineering, Structural Engineering and Construction Management
CSC 1005 : THEORY OF ELASTICITY

Time : 3 Hours Max. Marks : 60

Instruction : *Answer **any two** questions from **each** Module.*

Module – I

1. a) Show that the determination of principal stresses at a point is by the solution of the eigen value problem, $[\sigma]\{n\} = \sigma_n\{n\}$, where $[\sigma]$ is the stress tensor and $\{n\}$ is the vector of direction cosines of the principal axes.

   b) The state of stress at a point in a stressed body is given by $\sigma_x = x^2y + 20, \sigma_y = xz + y^2, \sigma_z = yz^2 + 10, \ \tau_{xy} = 3x^2y, \tau_{xz} = xz$ and $\tau_{yz} = yz$

   Determine the body force distribution at the point (1, 2, 3) so that the stresses are in equilibrium.

2. a) Derive the strain-displacement relations in a 3D system.

   b) Determine the principal strains and the direction of principal planes based on the following strain components.

   $\varepsilon_x = 1\times10^{-3}, \ \varepsilon_y = 1\times10^{-3}, \varepsilon_z = 3.5\times10^{-3}, \gamma_{xy} = 1.7\times10^{-3}, \gamma_{xz} = 0.8\times10^{-3}$

   and $\gamma_{xy} = 2.3\times10^{-3}$.

P.T.O.

3. a) Prove that Poisson's ratio cannot be greater than 0.5 for elasticity deformable bodies.

   b) The displacement field in a homogeneous isotropic linearly elastic body is given by $u = (x^2 + y^2 + z)i + (3x + 4y^2)\,j + (2x^3 + 4z)k$.

   Evaluate the stress components at point (1, 2, 3) if Lame's constants are, $G = 0.8 \times 10^5\ N/mm^2$ and $\lambda = 1.2 \times 10^5\ N/mm^2$. **(2×10=20 Marks)**

Module – II

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

   b) Using Airy's stress function approach, obtain expressions for the stresses developed in a simply supported beam subjected to a UDL of w/m length.

5. a) Derive the equations of equilibrium in 2D polar co-ordinate system.

   b) Explain :

      i) Airy's stress function ii) Biharmonic equation.

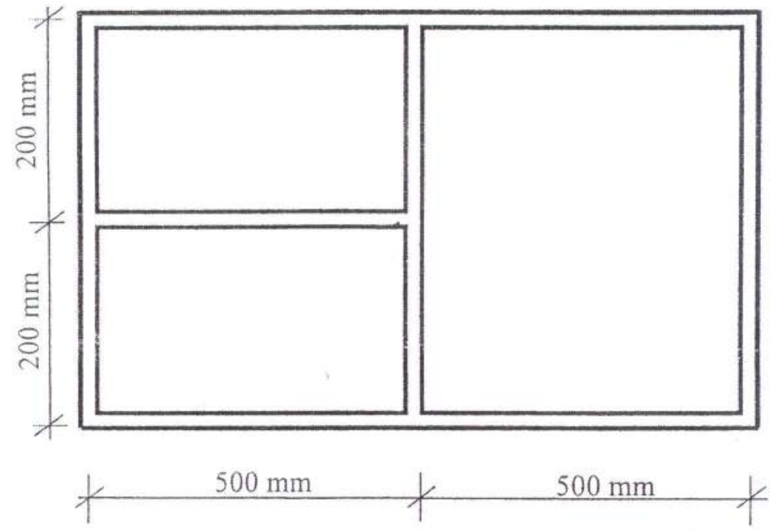
6. a) Explain axisymmetric problems in elasticity with examples.

   b) A thick cylinder of inner diameter 10 cm and outer diameter 12 cm is subjected to an internal fluid pressure of 10 N/mm^2. Plot the distribution of stresses in the body of the cylinder. **(2×10=20 Marks)**

Module – III

7. Show that for a shaft of any arbitrary cross-section, the torque transmitted is given by $T = 2\iint \phi\,dxdy$ and the angle of twist by $\theta = -\frac{1}{2G}\left(\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2}\right)$ where φ is the stress function.

8. A hollow thin wall torsion member shown in figure has uniform thickness of 1.5 mm and subjected to a torque of 30 kNm. Show that the interior walls are stress free.



9. a) Explain the terms 'yield criteria' and describe any one in detail.

   b) Explain how the elasto-plastic analysis of a beam problem can be performed ?

(2×10=20 Marks)