CBCS Scheme

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16/17CAE13

First Semester M.Tech. Degree Examination, Dec.2017/Jan.2018
Continuum Mechanics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. State and explain the assumptions made in theory of elasticity. **(04 Marks)**

b. Derive the differential equations of equilibrium in 2D and hence prove the complementary shear stress theory. **(12 Marks)**

OR

2 a. Derive Cauchy's stress relations for the resultant normal and shear stress on an arbitrary plane. **(08 Marks)**

b. Find the magnitudes of the principal stresses for the following stress tensor at a point.

$$\sigma_{tj} = \begin{bmatrix} 1 & 2 & 1 \\ 2 & -2 & -3 \\ 1 & -3 & 4 \end{bmatrix}.$$ **(08 Marks)**

Module-2

3 a. Given the following system of strains :

$\in_x = 5 + x^2 + y^2 + x^4 + y^4$

$\in_y = 6 + 3x^2 + 3y^2 + x^4 + y^4$

$\gamma_{xy} = 10 + 4xy(x^2+y^2+2)$

$\gamma_{yz} = \gamma_{zx} = 0 ; \in_z = 0$

Determine if this system of strains is possible. If yes then find the displacement and rotation when the origin is zero. **(08 Marks)**

b. Derive the strain compatibility equations in 3D and explain their significance. **(08 Marks)**

OR

4 a. State and explain generalized Hooke's law. **(04 Marks)**

b. Obtain the relationship between Lame's constant(λ) and Young's modulus (E) for a given isotropic and homogeneous material. **(04 Marks)**

c. The state of strain at a point is given by the following $\in_x = 0.001$ $\in_y = 0.003$ $\in_z = \gamma_{xy} = 0$ $\gamma_{xz} = -0.004$ $\gamma_{yz} = 0.001$. Take $E = 2 \times 10^5$ MPA $\nu = 0.28$. Calculate the state of stress at that point. **(08 Marks)**

Module-3

5 a. Explain the Airy's stress function. Derive the biharmonic equation in Cartesian co-ordinates for a two-dimensional case. **(08 Marks)**

b. Investigate what problem of plane stress is satisfied by the stress function:

$\phi(x, y) = \frac{3F}{4C}\left[xy - \frac{xy^3}{3C^2}\right] + \frac{P}{2}y^2$. Applied to the region included in y = 0 y = c x = 0 on the positive side. **(08 Marks)**

OR

6 a. Explain the use of polynomial of 3rd degree in the solution of rectangular beam problems. **(04 Marks)**

b. Derive the equations for the stress components for bending of a narrow cantilever beam of rectangular cross section subjected to a vertical downward load "P" at its free end. **(12 Marks)**

Module-4

7 a. Obtain the expression for radial and tangential stresses due to centrifugal load for rotating solid disk of uniform thickness. **(08 Marks)**

b. Show that in a rotating hollow disk, the maximum radial stress occurs at the geometric mean of outer and inner radii of the disk and hence determine maximum radial stress. **(08 Marks)**

OR

8 a. Obtain the Airy's stress function required to solve circular disk problems under thermal loading boundary conditions. **(12 Marks)**

b. Determine the radial and tangential stress equation for a solid disk when symmetrical temperature is exhibited. **(04 Marks)**

Module-5

9 a. Discuss the torsion of a solid circular cross –section bar. **(08 Marks)**

b. Discuss the torsion of thin –walled section. **(08 Marks)**

OR

10 a. What is understood by viscoelastic deformation? Name the materials which exhibit viscoelastic behaviour. **(04 Marks)**

b. State and explain the mechanical models to demonstrate viscoelastic behaviour of materials. **(12 Marks)**

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