Model Question Paper (CBCS) with effect from 2015-16

15ME552

USN | | | | | | | | | | |

Fifth Semester B.E. Degree (CBCS) Examination

Theory of Elasticity

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

MODULE – I

1 **a** A point under three dimensional stress system is on xyz coordinate system. Derive the Cauchy's stress equations for the component of the stresses on an arbitrary plane. (10 Marks)

b Explain stress invariants and plane state of stress. (06 Marks)

OR

2 **a** Derive expressions for Octahedral normal and Octahedral shear stresses in terms of stress invariants. (08 Marks)

b Rectangular component of stress at a point is given by $\sigma = \begin{bmatrix} 50 & 30 & 10 \\ 30 & 30 & 20 \\ 10 & 20 & 15 \end{bmatrix}$ MPa.

Determine the stresses on a plane whose outward normal (08 Marks)

a) Has direction cosines $\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0$

b) Has direction ratio 3, 2, -1

MODULE – II

3 **a** Discuss the significance of compatibility conditions. (10 Marks)

Given the following strain field:

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

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

$\gamma_{xy} = 10 + 4x^3y + 4y^3x + 8xy$

$\varepsilon_z = 0,\ \gamma_{yz} = 0,\ \gamma_{xz} = 0$

Determine whether the above strain field is possible.

b Displacement field at a point on a body is given as follows (06 Marks)
$u = (x^2yz+z^2)$; $v = (xy^2z+y^2)$; $w = (xyz^2+x^2)$. Determine the strain components at (2, 1, 2) and express them in matrix form.

OR

4 **a** Derive the first and second set of compatibility equations. (10 Marks)

b Define strain invariants and plane state of strain. (06 Marks)

MODULE – III

5 **a** Derive the biharmonic equation considering the plane strain condition in the Cartesian coordinate system. (10 Marks)

b The state of stress at a point is given by:

$\sigma_x = 200\,\text{MPa},\ \sigma_y = -100\,\text{MPa},\ \sigma_z = 50\,\text{MPa}$

$\sigma_{xy} = 40\,\text{MPa},\ \sigma_{yz} = 50\,\text{MPa},\ \sigma_{zx} = 60\,\text{MPa}.$

If E = $2\text{x}10^5$ N/mm^2 and G = $0.8\text{x}10^5$ N/mm^2, find the corresponding strain components from Hooke's law. Take ν=0.2. (06 Marks)

OR

6 **a** Derive the expressions for stresses in a thick cylinder under the uniform internal and external pressures. (16 Marks)

MODULE – IV

7 **a** Derive the expressions for stresses σ_r and σ_θ in a solid rotating disc of uniform thickness. (09 Marks)

b A solid disc of 150 mm radius rotates at 500 rpm. Given: mass density = 7.2 x 10^{-6} kg/mm^3, E = $2\text{x}10^5$ MPa and ν=0.3. Find the value of circumferential stress at the center of the disc and at the outer periphery. Also, find the change in radius. (07 Marks)

OR

8 **a** A disc of uniform thickness with inner and outer diameter 100 mm and 400 mm, respectively, is rotating at 5000 rev/min. The density of the material is 7800 kg/m^3 and ν=0.28. Determine the radial and circumferential stress at a radius of 0.05m. (08 Marks)

b A thin walled box section having dimensions 2a x a x t is to be compared with a solid circular section of diameter as shown in Fig. Q8(b). Determine the thickness *t* so that the two sections have (08 Marks)

a) The same maximum shear stress for the same torque and

b) The same stiffness

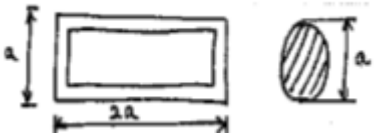

Fig. Q8(b)

MODULE – V

9 **a** Explain the significance of thermo-elastic stresses. Also, write the thermo-elastic stress strain relations. (06 Marks)

b Obtain the expressions for radial and tangential stresses in a solid circular cylinder subjected to uniform temperature. Also, obtain similar expressions for hollow cylinder. (10 Marks)

OR

10 **a** Derive Euler's expression for buckling load for column with both ends hinged. (08 Marks)

b Derive the expressions for stress components in a thin circular disc subjected to temperature. (08 Marks)