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** Derive the equations of equilibrium for a 2-D stress state. (08 Marks)

b State of stress at a point is given by $\sigma = \begin{bmatrix} 12 & 6 & 9 \\ 6 & 10 & 3 \\ 9 & 3 & 14 \end{bmatrix}$ MPa. Find principal stresses and directions. (08 Marks)

OR

2 **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. (08 Marks)

b A rectangular component of stress at a point are given as follows:
σ_x = 100 MPa, σ_y = 75 MPa , σ_z = 50 MPa
σ_{xy} = 70 MPa, σ_{yz} = 50 MPa, σ_{xz} = 30 MPa
a) Find stresses on octahedral plane
b) Stress on plane whose outward normal has direction cosines $\frac{1}{\sqrt{2}}$, 0, $\frac{1}{\sqrt{2}}$ (08 Marks)

MODULE – II

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

b The displacement field is given by u = (x^2+2z) ; v = $(4x+2y^2+z)$; w = $(4z^2)$. What are the strain components at (2, 2, 3) and express them in matrix form. (06 Marks)

OR

4 **a** Discuss the significance of compatibility conditions. Also, define plane state of strain. (06 Marks)

b If strain at a point is given as follows: (10 Marks)
$\varepsilon_x = 4\text{x}10^{-3}$, $\varepsilon_y = 3\text{x}10^{-3}$, $\varepsilon_z = 2\text{x}10^{-3}$
$\gamma_{xy} = 2\text{x}10^{-3}$, $\gamma_{yz} = 1\text{x}10^{-3}$, $\gamma_{xz} = -3\text{x}10^{-3}$
Find the principal strains and determine the direction cosines of maximum principal strain.

MODULE – III

5 **a** Determine the bending stress component in case of bending of cantilever bean by an end load. (09 Marks)

b A thick cylinder of internal diameter 150 mm and external diameter 200 mm is simultaneously subjected to internal pressure of 10 MPa and external pressure of 4 MPa. Given, E = $2\text{x}10^5$MPa and ν = 0.25. Determine: (07 Marks)

a) Circumferential stresses at r_i and r_o.
b) Plot variation of radial and hoop stress across the thickness.
c) Change in internal and external radii.

OR

6 **a** Derive the equations of equilibrium in polar coordinates. (10 Marks)

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

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

$\sigma_{xy} = 40\,\text{MPa},\ \sigma_{yz} = 50\,\text{MPa},\ \sigma_{zx} = 60\,\text{MPa}.$ (06 Marks)

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.

MODULE – IV

7 **a** Determine the maximum shear stress under torsion of a circular bar. (16 Marks)

OR

8 **a** Derive expressions for shearing stresses induced in a bar of elliptical cross section that is subjected to a twisting moment. Also, show that maximum stress occurs at the ends of the minor axis of ellipse. (08 Marks)

b A hollow disc of internal radius 100 mm and external radius 150 mm rotates at 200 rpm. Determine the circumferential stress at r_i and r_o. Also, find the change in internal and external radius. Assume: $\rho = 7.2 \times 10^{-6}$ kg/mm^3, E = 2×10^5 MPa and ν=0.3. (08 Marks)

MODULE – V

9 **a** Determine the radial and tangential stress distribution in a solid long cylinder subjected to a radial temperature distribution. (09 Marks)

b Derive Euler's expression for buckling load for column with one end fixed and other end free. (07 Marks)

OR

10 **a** Derive the expressions for stress components in a thin circular disc subjected to temperature. (10 Marks)

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