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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

First Semester, M.Tech - Civil Engineering (MCAD)

Make-up Examination; Feb - 2017

Continuums Mechanics-Classical and FE Approach

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

ii) If any missing data, Assume suitably.

UNIT - I

1 a. Derive equation of equilibrium for 2D element in Cartesian coordinate systems. 10

b. Derive the compatibility equation for a plane strain problem. 10

2 a. Derive the equation of two dimensional state of strain at a point. 12

b. Derive the strain-displacement relation for a 2D element in Cartesian Co-ordinate system. 8

UNIT - II

3 a. Write a note on stress polynomials and their limitations. 5

b. Investigate the problem of plane stress as

$\phi = \frac{q}{8c^3}\left[x^2\left(y^3 - 3c^2y + 2c^3\right) - \frac{y3}{5}\left(y^2 - 2c^2\right)\right]$ in the region $y = \pm c$ & $x = 0$ and also plot the stress on rectangular plate of size $(l \times 2c)$. 15

4 a. Derive the expression for bending of a cantilever beam subjected to a point load at the free end with usual notations. Take cross-section of beam as b = 1(unit width) and d = 2c [1 x 2c]. 15

b. State and explain St. Venant's principle with example. 5

UNIT - III

5 a. Derive an expression for thick walled cylinder subjected to Internal and External pressure with usual notations. 12

b. A thick cylinder of inner radius 150 mm and 25 mm thick is subjected to an internal pressure of 22 N/mm^2. Determine the radial and hoop stress in the cylinder at inner and outer surfaces. 8

6 a. Derive expression for pure bending of curved bar. 10

b. Derive 2D equilibrium equation in polar coordinate system. 10

UNIT - IV

7 a. Explain briefly : 9

i) Principal stress and Principal plane

ii) Stress invariants

iii) Octahedral stress.

Contd…2

b. A rectangular metal bar element of cross-section 60 x 30 mm and is subjected by axial tensile force of 250 kN. Determine, normal, shear and resultant stresses on a plane whose normal has following direction cosines : 11

i) $l = m = \frac{1}{\sqrt{2}}$ & $n = 0$ ii) $l = m = n = \frac{1}{\sqrt{3}}$.

8. The stress components at a point in a stressed body are as follows :

$\sigma_x = 0.5$ $\sigma_y = 0.7$ $\sigma_z = 0.6$

$\tau_{xy} = 1.0$ $\tau_{zy} = 1.2$ $\tau_{zx} = 0.8$ 20

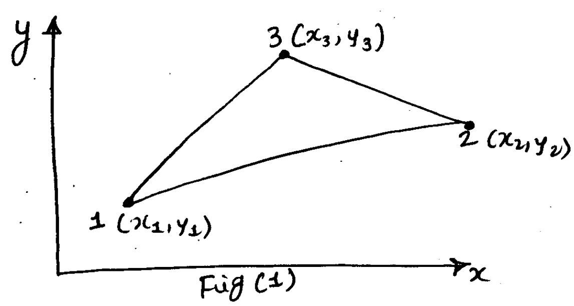
Determine :

i) Principal stress and Principal planes ii) Hydrostatic and Deviational stress

iii) Maximum shear stress iv) Octahedral stress (Normal and shear stresses).

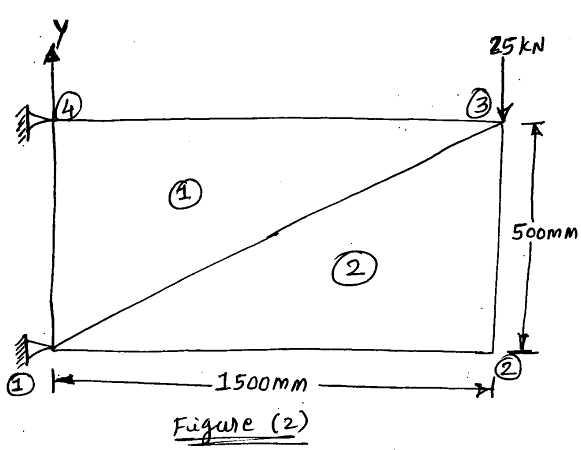
UNIT - V

9 a. Determine the shape function for the constant strain triangle (CST). Use polynomial functions, as shown in Fig (1). 12



b. List out and explain the use of Gauss qudrature for numerical integration. 8

10. Determine the displacements at the nodes for the following 2D solid continuum considering a constant thickness of 25 mm, Poisson's ratio, μ as 0.25 and Modulus of elasticity 'E' as $2x10^5$ N/mm^2. The continuum is discritized with two CST plane, stress elements as shown in Fig. 2. 20



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