U.S.N

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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; Jan - 2017

Continuous 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) Assume missing data if any.

UNIT - I

1 a. The stress components at a point in a body are given by,

$\sigma_x = 3xy^2z + 2x \qquad \sigma_y = 5xyz + 3y \qquad \sigma_z = x^2y + y^2z$

$\tau_{xy} = 0 \qquad \tau_{yz} = \tau_{xz} = 3xy^2z + 2xy$

Determine whether these components of stress satisfy the equilibrium equations or not at the point (1, -1, 2). If not then determine the suitable body force vector required at this point so that these stress components are in equilibrium with the external force. 12

b. Derive the differential equation of equilibrium for two dimensional problem. 8

2 a. Derive the compatablity equation for plane strain problem. 10

b. Using stress-strain relationship show that in the absence of body forces the displacement problems of plane stress must satisfy,

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{(1+\mu)}{(1-\mu)}\frac{\partial}{\partial x}\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right) = 0$$

10

UNIT - II

3. A cantilever of uniform rectangular section and depth 2C is subjected to a point load P at its end as shown in fig.1 using the following conditions,

$At \quad x = L \quad y = 0 \quad u = v = 0$

$\quad\;\; x = L \quad y = \pm c \quad u = 0$

Show that the deflection is given by,

$$V_{\substack{x=0\\y=0}} = \frac{PL^3}{3EI}\left(1 + \frac{1}{2}[4+5\mu]\frac{C^2}{L^2}\right)$$

20

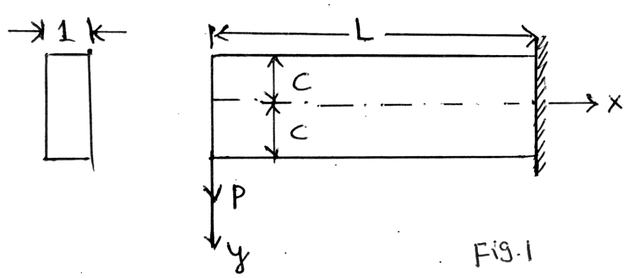

Fig.1

Contd....2

4 a.	Using a stress function in the form of a polynomial of the fourth degree. Plot the stress on a rectangular plate of size $2C \times L$.	12
b.	Explain the use of polynomials in the solution of rectangular beam problems.	4
c.	Write a short note on Airy's stress function.	4

UNIT - III

5.	Discuss the bending of a curved bar subjected to a concentrated force at the end.	20
6 a.	Derive the partial differential equation of equilibrium in polar co-ordinates for 2 dimensional body.	10
b.	Derive the general expression for the stress components in the case of axis-symmetric distribution.	10

UNIT - IV

7. The state of stress at a point is given by the following matrix, — 20

$$\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix} \text{MPa}$$

Find the principal stresses and check the invariance. Also determine the principal directions.

8 a. The strain tensor at a point in a body is given by, — 16

$$E_{ij} = \begin{bmatrix} 0.0005 & 0.0008 & 0.0007 \\ 0.0008 & 0.0004 & 0.0006 \\ 0.0007 & 0.0006 & 0.0003 \end{bmatrix}$$

Determine:

(i) Octahedral normal and shearing strain

(ii) Deviator and spherical strain tensors.

b. Explain strain tensor. — 4

UNIT - V

9 a.	Develop the Jacobean matrix for the three noded triangular. Also derive the strain displacement matrix for CST element.	14
b.	What are the isoparametric, sub parametric and super parametric element with neat sketches.	6
10 a.	Derive the shape function for eight-noded rectangular element using natural co-ordinate.	10
b.	Develop the strain-displacement matrix for the axis symmetric element for three noded triangular elements.	10

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