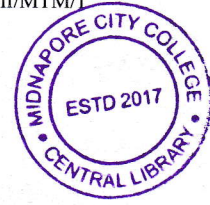


PG CBCS
M.A. Semester-II Examination, 2022
MATHEMATICS
PAPER: MTM 205

(GENERAL THEORY OF CONTINUUM MECHANICS)

Full Marks: 40

Time: 2 Hours



GROUP-A

1. Answer any four questions of the following:

4×2=8

- a) Define Strain quadratic .
- b) Write the differences between stream line and path line.
- c) Define green elastic material.
- d) The components of the stress dyadic at a certain point of a continuous

medium are given by $(E_{ij}) = \begin{pmatrix} 200 & 400 & 300 \\ 400 & 0 & 0 \\ 300 & 0 & -100 \end{pmatrix}$

Determine the maximum shear stress.

- e) Consider the following displacement components due to deformation in a continuum body $u_1 = 0.3X_1^2 + 0.5X_2$, $u_2 = 0.2X_2^2 + X_3$, $u_3 = 0.4X_3 + X_1$.

Find the small rotation tensor at the point (2, 0, -1) in the body.

- f) The velocity (u, v, w) of a fluid at a point P(x, y, z) is given by $u = \frac{-2xyz}{x^2+y^2}$, $v = \frac{yz}{x^2+y^2}$, $w = \frac{z}{x^2+y^2}$. Find the rate at which density of the fluid at point P is decreasing in the flow field.

GROUP-B

2. Answer any four questions of the following:

4×4=16

- a) Show that the equation of continuity between Eulerian and lagrangian forms are equivalent.
- b) Define image. Find the image of a source with respect to a straight line.

- c) The strain tensor at a point is given by $(E_{ij}) = \begin{pmatrix} 5 & 3 & 0 \\ 3 & 4 & -1 \\ 0 & -1 & 2 \end{pmatrix}$.

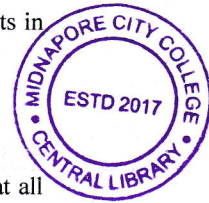
Determine the extension of the line element in the direction of $(\frac{2}{3}, \frac{2}{3}, \frac{1}{3})$.

[P. T. O]

[2]

What is the change of angle between two perpendicular line elements in the directions of $(\frac{2}{3}, \frac{2}{3}, \frac{1}{3})$ & $(\frac{1}{\sqrt{5}}, 0, \frac{2}{\sqrt{5}})$?

- d) Discuss the volumetric strain for small deformation of a body.
- e) Define principal strain and principal direction of strain. Prove that all principal strains are real
- f) The velocity components in a fluid are given by $u = x^2 + z^2, v = y^2 + z^2, w = -2z(x + y)$. Show that the flow is possible. Examine whether the motion is rotational or not.



GROUP-C

3. Answer any two questions of the following: 2×8=16

- a) Derive the basic elastic constants for isotropic elastic solid.
- b) (i) State and prove the cauchy's first equation of motion. When the continuum is in static equilibrium? Deduce the equation of equilibrium.
- (ii) A stress field is given by $T_{11} = 20x_1^3 + x_2^3, T_{12} = x_3, T_{23} = x_1^3, T_{31} = x_2^3, T_{22} = 30x_1^3 + 200, T_{33} = 30x_2^2 + 2003x_3^2$. What are the components of the body force required to ensure equilibrium.
- c) Derive the equation of energy for perfect fluid.
