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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 <u>four</u> 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 <u>four</u> 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 $\left(\frac{2}{3}, \frac{2}{3}, \frac{1}{3}\right)$.

[P. T. O]

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

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 <u>two</u> 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.

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