GATE PATHSHALA

Fluid Mechanics and Aerodynamics (Assignment-01: Questions)

Author Name: Mohd Abrar Nizami

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Total Acceleration, Convective Acceleration, and Local Acceleration

Question 1: Understanding Total Acceleration

A velocity field in two-dimensional flow is given as:

$$\mathbf{V} = (2xy)\mathbf{i} + (x^2 + y^2)\mathbf{j}$$

Find the total acceleration at the point $(1, 2)$.

Question 2: Local and Convective Acceleration Components

A fluid velocity in cylindrical coordinates is given as:

$$V_r = 3r^2t, \quad V_\theta = 2r\theta$$

Find the **local acceleration** and **convective acceleration** at $(r, \theta) = (2, \frac{\pi}{4})$ when $t = 1$.

Question 3: Understanding Total Acceleration

A velocity field is given as:

$$V_x = 5x^2y, \quad V_y = 4xy^2$$

Find the total acceleration at the point $(2, 1)$.

Question 4: Acceleration in a Radial Flow

Problem: A fluid has a **radial velocity field** in cylindrical coordinates:

$$V_r = Are^{-t}, \qquad V_\theta = 0, \qquad V_z = Bzt. \qquad (1)$$

Find the **total acceleration** in cylindrical coordinates.

Question 5: Total Acceleration

Problem: The velocity field in two dimensions is given as:

$$\mathbf{V} = (u, v) = (x^2 t, y t^2)$$

Find the total acceleration.

Question 6: Total Acceleration in polar coordinates

Given a velocity field in polar coordinates:

$$V_r = r^2 t, \quad V_\theta = r t^2$$

compute the total acceleration components.