INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
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Department of Civil Engineering
Course: CE21003
Submission Deadline:
Total Marks:

Fluid Kinematics

Q1) Consider steady, incompressible, two-dimensional flow through a converging duct. A simple approximate velocity field for this flow is

$$\vec{V} = (u, v) = (U_0 - bx)\,\vec{\imath} - by\,\vec{\jmath}$$

where U_0 is the horizontal speed at $x = 0$. Note that this equation ignores viscous effects along the walls but is a reasonable approximation throughout the majority of the flow field. Calculate the material acceleration for fluid particles passing through this duct. Give your answer in two ways: (1) as acceleration components a_x and a_y and (2) as acceleration vector $\vec{a}$

Q2) Consider the following steady, two-dimensional velocity field:

$$\vec{V} = (u,v) = (-0.781 - 4.67x)\vec{\imath} + (-3.54 + 4.67y)\vec{\jmath}$$

Is there a stagnation point in this flow field? If so, where is it?

Q3) Converging duct flow is modelled by the steady, two-dimensional velocity field of Prob.1. The pressure field is given by.

$$P = P_0 - \frac{\rho}{2}\left[2\,U_0\,bx + b^2(x^2+y^2)\right]$$

Q4) Generate an equation for the streamlines for the given velocity field.

$$\vec{V} = (u, v) = (U_0 - bx)\,\vec{\imath} - by\,\vec{\jmath}$$

Q5) Generate an equation for the pathline for the given velocity field at (1,2,4).

$$\vec{V} = (u, v, w) = 4x\,\vec{\imath} + (5y+3)\,\vec{\jmath} + 3t^2\,\vec{k}$$