

## Homework III

Due Feb 2, 2018.

- 1 Compute the acceleration of a fluid particle for the velocity fields  $\Omega(-y, x, 0)$  and  $e(x, y, -2z)$ . Discuss.
- 2 [Kundu 3.10] Show that the divergence of the vorticity field vanishes for any flow.
- 3 Find the streamfunction (if it exists), the velocity potential (if it exists) and the steady density field (if it is determined) corresponding to the following two-dimensional steady velocity fields:
  - $\mathbf{u} = (x, -y)$
  - $\mathbf{u} = (-y, x)$
  - $\mathbf{u} = (x, 0)$

What happens if  $\rho$  is allowed to vary with time?

- 4 [Kundu 4.12] The components of a mass flux vector are  $\rho\mathbf{u} = (4x^2y, xyz, yz^2)$ . Compute the net outflow through the closed surface formed by the planes  $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$ .