Quiz 5: Conservation of Mass and Momentum Equation - 2

September 25, 2025

Q1.- Let's assume you are asked to determine the velocity field, for a Newtonian, incompressible flow. What are the differential equations that you should consider using to solve the problem.

- (a) Write down the equations first in index notation.
- (b) Rewrite the equations for the specific case of a 2D flow field.

Q2.- How would your response to Q1(a) change if the flow was instead compressible and Newtonian?

Q3.- Rewrite the equations in Q1(b) assuming that the flow is fully developed in the y-coordinate. What is the direct implication of that for the x-coordinate flow component?

Q4.- In a 2D Newtonian, incompressible channel flow (*i.e.* the flow is bounded by solid, non-porous, static walls), forced by a constant pressure gradient in the streamwise direction, how does the shear stress vary in the vertical direction (y), assuming that shear is defined as $\tau_{xy} = \mu \frac{\partial u}{\partial y}$?