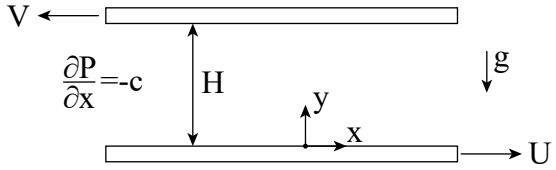
Homework #9

MEMS 0071 - Introduction to Fluid Mechanics

Assigned: November 10th, 2019
Due: November 15th, 2019

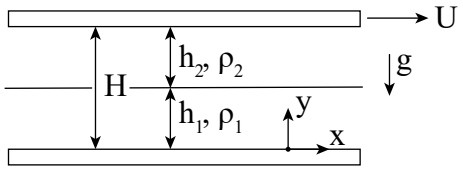
Problem #1

Consider a situation where a fluid exists between two infinite, parallel plates that are moving in opposite directions. The bottom plate is moving in the positive x-direction with a velocity of U, and the top plate is moving in the negative x-direction with a velocity V. The two plates are separated by a distance H. A pressure gradient is applied in the positive x-direction. Gravity is acting in the negative y-direction. Construct an expression for the velocity profile in the x-direction. Assume the flow is incompressible, steady-state, laminar, isotropic and Newtonian.



Problem #2

Consider a Couette flow were there are two immiscible fluids existing between two infinite, parallel plates. The top plate moves with a velocity magnitude U in the positive x-direction while the bottom plate is stationary. The plates are separated by a distance H. Fluid 1 has a density ρ_1, viscosity μ_1 and has a height h_1. Fluid 2, on top of fluid 1, has a density ρ_2, viscosity μ_2 and a height of h_2. It is noted $h_1+h_2=H$. The interface between the two liquids is assumed parallel to the top and bottom plates. Gravity acts in the negative y-direction. Assume the flow is steady-state and laminar, and the fluids are incompressible, isotropic and Newtonian. Construct an expression for the velocity profile in the x-direction. Hint: think about the two boundary conditions existing at the fluid interface.



Problem #3

Consider a situation where a fluid exists between two infinite, parallel plates that are inclined above the x-axis by some angle γ. The bottom plate is stationary, whereas the top plate is moving with some velocity U. The plates are separated by a distance H. Gravity is acting in the negative y-direction. Construct an expression for the velocity profile of the fluid. Assume the flow is incompressible, steady-state, laminar and Newtonian.