BM4040 Mechanobiology

Problem set 1

Instructions

- You are not expected to submit answers to these problems.

Questions

1. Derive the expressions of velocity, volumetric flow rate, and wall shear stress for pressure driven flow in a cylindrical channel with circular cross-section.
2. Redo the previous question where pressure on the channel inlet is oscillatory, and outlet pressure is help fixed, as given below

$$p_i(t) = p\sin(\omega t)$$
$$p_o(t) = 0$$

3. Redo the Couette flow example done in class where a pressure gradient is also applied along with the moving top plate.
4. Determine a relationship for the radii of blood vessels that branch out from a parent vessel of radius R to two progeny branches of radii R_1 and R_2 (not necessarily equal) such that the shear stress resulting from laminar blood flow on the inside of these vessels remains constant. Ignore fluid effects at the bifurcation itself. You may assume that blood is Newtonian and incompressible.