Name: _____

ABE 307
Fall 2017
Test 2 : Take Home Test
Assigned: Oct 26th, 2017
Due: Oct 30th, 2017

Suggested Time	60 minutes
Actual Time Spent	

Treat this Take Home Test as a real exam. Time yourself for solving, however you are free to use any amount of time needed to complete the problems. The test will only be evaluated for completeness. All problems must be fully solved, including all integrals and providing a final answer. **Solutions left incomplete will be treated as unattempted and 0 points will be given for whole test**. **Full points will be given to a complete test, regardless of accuracy of the solutions**. Also, record your actual time for the test after you have finished. Actual time spent has no implications for your points, this statistics is being collected to gain insight into proper length of exam to be used in future. Only use the provided appendix for solving test. **It is recommended to NOT look at class solutions or any other notes for solving this test.**

If you need to use additional pages, that is allowed. Staple it to the main test.

Problem	Points	Points Obtained
1	30	
2	15	
Total	45	

1. The space between two coaxial cylinders is filled with an incompressible fluid at constant temperature. The radii of the inner and outer wetted surfaces are kR and R, respectively. The angular velocities of rotation of the inner and outer cylinders are Ω_i and Ω_o. Assume steady state.

a) Draw the geometrical picture for the flow situation described above clearly showing the coordinates. (3)
b) Determine the velocity distribution in the fluid. (15)
c) Derive the relationship for torque exerted by the fluid on both outer and inner cylinder. Explain the sign for each expression obtained. (12)

2. A straight duct extends in the z direction for a length L and has a square cross section, bordered by the lines $x = \pm B$ and $y = \pm B$. The velocity distribution is given by

$$v_z = \frac{(P_0 - P_L)\, B^2}{4\mu L} \left[1 - \left(\frac{x}{B}\right)^2\right]\left[1 - \left(\frac{y}{B}\right)^2\right].$$

Derive the equation for mass flow rate in the square duct.