MAE 214A, Winter 2009

Homework 1

Due Tuesday, Jan. 15, in class

Guidelines: Please turn in a *neat* homework that gives all the formulae that you have used as well as details that are required for the grader to understand your solution. Note that the work must be your own; no use of solutions from other sources.

1. Problem 2.10, Pope. Start from the incompressible Navier-Stokes equations in index notation.

2. Problem 4.5, Pope. Do all parts. In part (a), calculate only b_{ij}, as defined in class.

3. Consider a well-established plane jet of water that emerges from a slot. Let x be the coordinate along the jet axis, y be the cross-stream coordinate along which the slot thickness is b, let z be the spanwise coordinate and t be time.

a. Suppose the jet is laminar and you are asked to solved for the velocity, U. What are the independent variables that U is a function of? Give the equations that you would use to solve for U. Make all simplifications that you are allowed to make in these equations, *giving reasons*. No need to solve the equations.

b. Repeat part (a) for the velocity, U, of a turbulent jet. If there is a turbulence closure problem, identify the terms that need to be modeled.

c. Repeat part (c) for the mean velocity, $< U >$, of a turbulent jet. If there is a turbulence closure problem, identify the terms that need to be modeled.

d. Perform a literature survey to find values of Reynolds number at which transition to turbulence takes place in a plane jet.