AME 538
Homework 1
Due: Friday, 25 August 2000, in class

1. Respond to my e-mail message if you received it.

2. Retrieve document sample.tex and sample.figure from the "documents" link under

   http://www.nd.edu/∼powers/ame.538,

   edit it to add your name, and print a copy of the compiled file. You should save sample.figure as sample.figure.eps

3. Consider a flow which has variation in one spatial dimension, denoted by x, and time, denoted by t. The material derivative (also known as the total derivative, substantial derivative, or derivative following a fluid particle) of an arbitary flow variable $f(x,t)$, where f could represent, e.g. temperature, pressure, density, etc., is defined as

$$\frac{df}{dt} = \frac{\partial f}{\partial t} + u\frac{\partial f}{\partial x}.$$

   Show that the material derivative is invariant under a Galilean change of reference frame (as it must be in the context of Newtonian, but not Einsteinian, physics). In a Galilean transformation we map $(x,t) \to (x',t')$ and $u \to u'$ via the mappings

$$\begin{aligned} x' &= x - Vt, \\ t' &= t, \\ u' &= u - V. \end{aligned}$$

   Here V is a constant velocity of the moving reference frame.