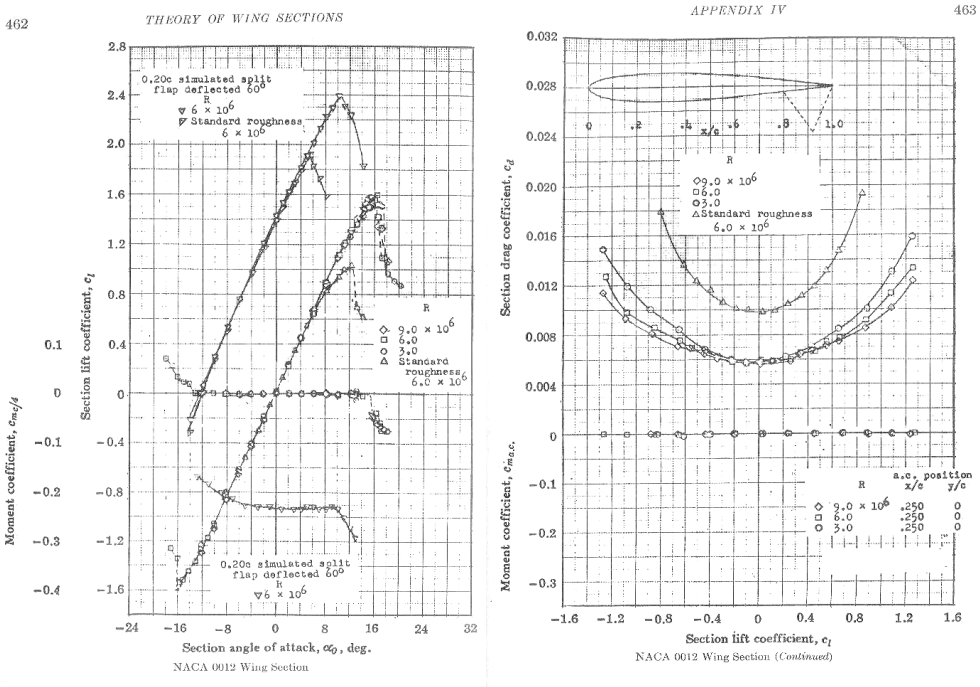
AEM 313 Problem Set #2

Due: 6th September 2016 by 11:00am

1. Determine the density at 20000 ft on a non-standard but dry day. The sea level pressure is 30.14 in-Hg ("inches of Mercury" in a manometer). The sea level temperature is 90° F with a lapse rate of:

$$\lambda = \begin{cases} -0.005 \frac{R}{ft} & h < 10000\ ft \\ 0 & h \geq 10000\ ft \end{cases}$$

2. For an NACA 0012 operating at a Reynolds number in excess of 10 million,
   - Determine the lift, drag, and quarter chord moment coefficient at 10° AOA.
   - Determine $C_{l\max}$ and discuss what occurs to lift and moment near stall.



3. Variable density wind tunnels were a significant advance to allow testing of small models at full-scale aircraft Reynolds numbers.
   - For a 1/10th scale model, determine the pressure necessary to match both the Reynolds number and Mach number at SSL for a given wind tunnel model.
   - Water is 1000 times denser than air. Is a model in a water tunnel feasible for matching both the Mach number and Reynolds number of a full size vehicle? What if the Mach number constraint is relaxed?
4. A Cessna 182 has a wing area of 174 sq-ft and a 230 horsepower engine.
   - Determine $C_{L\max}$ if at a gross weight of 3100 lbf, we observe a stall speed of 49 knots.
   - Estimate the propeller efficiency if the aircraft maximum SSL cruise speed at 3100 lbf is 145 knots. The estimated drag coefficient is $C_D = 0.0250 + 0.054 C_L^{\ 2}$.