AOE 2104 Problem Sheet 1 (ans)

1. Write down ***your*** definition of Engineering.

2. Give an example of how your definition applies to the general field of Aerospace Engineering.

3. The F/A 18 aircraft lands at approximately 160 kts. Determine the landing speed in
   a) miles per hour
   b) ft/sec
   c) meters /sec

a) $V = 160 \text{ kts} \cdot \dfrac{1.1508 \text{ mi/hr}}{1 \text{ kt}} = 184.1 \text{ mi/hr}$

b) $V = 160 \text{ kts} \cdot \dfrac{1.6878 \text{ ft/sec}}{1 \text{ kt}} = 270.0 \text{ ft/sec}$

c) $V = 160 \text{ kts} \cdot \dfrac{0.5144 \text{ m/s}}{1 \text{ kt}} = 82.3 \text{ m/s}$

4. Determine the pressure, density, and temperature in a standard atmosphere at an altitude of 23,000 ft. (in customary English units and in the corresponding altitude in meters, and SI units)

$$h = 23{,}000 \text{ ft} \cdot \frac{0.3048 \text{ m}}{1 \text{ kt}} = 0.7010.4 \text{ m}$$

Since the altitude is given at a table point, we can just look up the values for the English system and convert:

$$P = 857.24 \text{ lbs/ft}^2 \cdot \frac{47.86026 \text{ N}_\text{m}^2}{1 \text{ lb/ft}^2} = 41044.9 \text{ N/m}^2$$

$$\rho = 0.0011435 \text{ slugs/ft}^3 \cdot \frac{515.379 \text{ kg/m}^3}{1 \text{ slug/ft}^3} = 0.5893 \text{ kg/m}^3$$

$$T = 436.76 \text{ deg R} \cdot \frac{5 \text{ deg K}}{9 \text{ deg R}} = 272.64 \text{ deg K}$$

Alternatively we could interpolate the values in the SI tables:

$h_L = 6900 \qquad P_L = 41686 \qquad \rho_L = 0.59676 \qquad T_L = 243.26$

$h_u = 7200 \qquad P_U = 39963 \qquad \rho_U = 0.57671 \qquad T_U = 241.41$

The pattern for all these interpolations is:

$$P = P_L + \frac{h - h_L}{h_U - h_L} \cdot (P_u - P_L) = 41868 + \frac{(7010.4 - 6900)}{(7200 - 6900)} \cdot (39963 - 41686) = 41051.9 \text{ N/m}^2$$

$$\rho = 0.59676 = (0.3680)(0.57671 - 0.59676) = 0.5894 \text{ kg.m}^3$$

$$T = 243.36 + 0.3680\,(341.41 - 243.36) = 242.64 \text{ deg K}$$

5. An aircraft is flying at 500 kts in standard sea-level conditions. Determine its Mach number.

$$M = \frac{V}{a} = \frac{\dfrac{500 \text{ kt} \cdot 0.5144 \text{ m/s}}{1 \text{ kt}}}{340.29 \text{ m/s}} = 0.756 \qquad M_a = \frac{500 \text{ kt} \cdot 1.6878 \text{ ft/sec/kt}}{1116.4 \text{ ft/sec}} = 0.756$$