Module 5 Homework

1.

a. Aircraft: Cessna 172 Skyhawk

b. Cruise Altitude: 10,000 feet (3,048 meters)
Standard Temp at 10,000 feet: -49.9°C
Standard Pressure at 10,000 feet: 236.36 hPa
Standard Density at 10,000 feet: 0.4135 kg/m^3

c. Wing Area: 174 sq/ft (16.17 sq/m)

d. Average Chord: 1.76 meters

e. Wing Span: 36 ft. 1 in. (10.99 meters)

f. Cruise Speed: 124 knots (229.7 km/h or 142.7mph)

g. Takeoff Weight: Max T/O = 2,450 lbs. (1,111.3 kg)

2. Calculate dynamic viscosity at cruise altitude:

$(1.7894 \times 10^{-5}\ kg/m/s)(223.25288.15)^{3/2}$

$(288.15 + 110.4223.25 + 110.4)\ \mu =$

$(1.7894 \times 10^{-5})(288.15223.25)^{3/2}(223.25 +$

$110.4288.15 + 110.4)$

Calculate Re:

$(0.4135\ kg/m^3) \times (63.8\ m/s) \times (1.76m)$

3. Aspect Ratio $= AR = \frac{b^2}{A} = \frac{\text{wing span}^2}{\text{wing area}}$

$= \frac{14^2}{49} = \frac{196}{49}$ $AR = 4$

4. $a_0 = 0.11$

$\left(\frac{dc}{dx}\right) = 0.11 = a_0$; $e_1 = 0.92$

$A = 4\ am^2$

$AR = \frac{b^2}{S} = \frac{(14)^2}{49} = 4$

w.k.t

$$a = \frac{dcl}{dx} = \frac{a_0}{1 + \frac{57.3 \cdot 3a_0}{\pi AR e_1}}$$

$$a = \frac{0.11}{1 + \frac{(57.3)0.11}{3.14 \times 4 \times 0.92}} = 0.0711\ deg$$

5. $AR = 25\%$

$AR = (0.25)$

$AR = 4 + 1 = 5$

$$a = \frac{0.11}{1 + \frac{(57.3)(0.11)}{3.14 \times 5 \times 0.90}} = 0.7658$$

$AR = 4 - 1 = 3$

$$a = \frac{0.11}{1 + \frac{(57.3)(0.11)}{3.14 \times 3 \times 0.90}} = 0.06368$$

If AR is increased by 25% ; $a = 0.07658$

If AR is decreased by 25% ; $a = 0.06368$

Scope increases by 7.70%

Scope decreases by 10.43%