Flight Dynamics 1 (AS 2040) Assignment 1 Due on: 31-10-2014

1. A jet aircraft weighing 60000 N has its line of thrust 0.15 m below the line of drag. When flying at a certain speed, the thrust required is 6000 N and the center of pressure of the wing lift is 0.45 m aft of the airplane c.g. What is the lift on the wing and the load on the tail plane whose center of pressure is 7.5 m behind the c.g.? Assume unaccelerated level flight and the angle of attack to be small during the flight.

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2. Derive equations for variation of pressure and density in the middle stratosphere (20 to 32 km altitude). Show that (note in this case $\lambda = -0.001\ K/m$):

$$\frac{p}{p_{20}} = \left(\frac{T}{T_{20}}\right)^{-34.1632}, \qquad \frac{\rho}{\rho_{20}} = \left(\frac{T}{T_{20}}\right)^{-35.1632}.$$

where p_{20}, ρ_{20} and T_{20} are pressure, density and temperature respectively at 20 km altitude.

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3. Calculate the temperature (T), pressure (p), density (ρ), pressure ratio (δ) , density ratio (σ), speed of sound (a) , coefficient of viscosity (μ) and kinematic viscosity (ν) in I.S.A. at altitudes of 8 km, 16 km and 24 km.

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4. On a certain day the pressure at sea level is 98900 N/m^2 and the temperature is 25^0C. The temperature is found to fall linearly with height to -55^0C at 12 km and after that it remains constant. Calculate the pressure, density and kinematic viscosity at 8 km and 16 km altitude.

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5. An airplane weighing 100000 N is powered by an engine producing 20000 N of thrust under sea level standard conditions. If the wing area be 25 m^2, obtain the maximum and minimum speed in steady level flight at sea level. Assume $C_{Lmax} = 1.5$, $C_D = 0.016 + 0.064{C_L}^2$, and $\rho = 1.225\ kg/m^3$ at sea level.

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