Aircraft Mechanics II

(Course Code: AE 305/305M/717)

Department of Aerospace Engineering
Indian Institute of Technology Bombay

Instructor: Shashi Ranjan Kumar

January 25, 2021

Tutorial 1

TA: Rohit Nanavati

Assume that the sea-level air density is 1.225 kg/m^3.

1. (a) Prove that the maximum value of the ratio C_L/C_D is independent of attitude and free stream velocity, rather, they depend only on the aerodynamic design of the aircraft.

   (b) Consider an airplane with zero-lift drag coefficient of 0.025, an aspect ratio of 6.72, and span efficiency factor (Oswald efficiency factor) of 0.9. Using the results of part (a), calculate the value of $(L/D)_{max}$.

2. Show that the rate-of-climb is maximum, when the aircraft is moving at a speed of

$$V_{RCmax} = \sqrt{\frac{2T}{3\rho C_D S}}.$$

   Consequently, the maximum climb rate is given by

$$RC_{max} = \sqrt{\frac{8T^3}{27W^2\rho S C_D}}.$$

   Assume the usual meaning to variables T, ρ, S and C_D.

3. Consider an aircraft with maximum lift coefficient (with no flap deflection) of 1.5, wing area of 15 squared meter, weight of 25000 N. Furthermore, the aircraft can structural bear a maximum positive lift force of 1,000,000 N. Is it possible for the aircraft to maneuver at the a sea-level corner velocity of 100 m/s? Justify your answer.

4. The maximum lift coefficient for an aircraft is 1.5 along with a zero-lift drag coefficient of 0.3. Neglecting the induced drag on the aircraft, what is the equilibrium glide velocities corresponding to minimum glide angle and a wing loading of 3000 N/m^2. Furthermore, if the aircraft is in flight at 1500 m of altitude when the engine fails, how far can it glide in terms of distance measured along the ground? (Assume the density of air at 1500 m to be 1.05 kg/m^3)