Assignment 2: Basic Performance Observations and Calculations

Date Due: February 7, 2020 Instructor: Trani

Problem 1

Use the Eurocontrol interactive BADA database (https://contentzone.eurocontrol.int/aircraftperformance/default.aspx?) and Flightaware to answer the following questions:

a) Frontier Airlines flies Airbus A319 between CLT (Charlotte) and DEN (Denver). Find the typical cruise Mach number for the A319 aircraft according to the BADA database. The ICAO code name for the Airbus A319 in the BADA database is A319.

b) Use Flightaware to check 2 Frontier flights using A319 aircraft in the last 3 days and verify the typical altitudes flown between CLT and DEN. Compare the observed altitudes to those reported in BADA database.

c) Use the graphical profile of the BADA database for the A319 to estimate the typical time to climb to 34,000 feet. Pay attention to the variations in rate of climb across various altitudes.

d) Find the RECAT 1 wake vortex group for the Airbus A319. Consult the Airbus information for airport planning (see links at the relevant Aircraft Manufacturer Documents and Web Information on our web site - http://128.173.204.63/courses/cee5614/sites_ce_5614.html#Aircraft_Data).

e) Compare the cruise performance of the Airbus A319 with that of a regional aircraft like the Embraer 135 (ICAO code E135). Comment on differences and similarities.

Figure 1. Airbus A319 Departing Reagan National Airport (A. Trani).

Problem 2

Use the Matlab computer program ISAM.m (available in the Matlab files section of our web site - http://128.173.204.63/courses/cee5614/matlab_files_cee5614.html) to answer the following questions:

a) An Airbus A340-300 of Lufthansa flies at Mach 0.82 and at 38,000 feet. Assuming ISA atmospheric conditions, find the true airspeed (in knots) of the aircraft and the typical outside atmospheric temperature at the cruise altitude (Flight Level 380).

b) An aircraft performs a descent from FL380 at a constant indicated airspeed of 240 knots. Estimate the value of true airspeed under ISA conditions at 10,000 feet and 5,000 feet.

Figure 2. Airbus A330-300 Landing at Charlotte Airport(A. Trani).

c) If the the Flight Management Computer (FMS) of aircraft in part (a) of this problem reports a 97 knot tailwind while cruising at FL380. Find the ground speed of the aircraft.

Problem 3

An American Airlines CRJ-900 departs Charlotte airport. The pilot follows the indicated speed profile shown in the table.

Figure 3. American Airlines Bombardier CRJ-900 Departs Charlotte (A. Trani).

Table 1. Indicated Speed Climb Profile.

Altitude (meters)	Indicated Airspeed (knots)
200	170
2000	210

Altitude (meters)	Indicated Airspeed (knots)
3,000	230
5,000	250
6,000	265
7,000	270
8,000	270
9,000	270

a) Estimate the true airspeeds (TAS) for each one of the points in the climb profile. Assume ISA atmospheric conditions and zero wind in your calculations. Plot the values of TAS vs altitude.

b) Find the true Mach number at 8,000 meters.

Problem 4

The minimum flight speed achievable in steady-flight (called stalling speed V_{stall}) can be estimated using the fundamental lift equation:

$$V_{stall} = \sqrt{\frac{2mg}{\rho S C_{l\max}}}$$

where: m is the aircraft mass (in kilograms), g is the gravity constant (9.81 m/s-s), S is the aircraft wing area (square meters), ρ is the air density (kg/cubic meter) and $C_{l\max}$ (dimensionless) is the maximum lift coefficient (a parameter determined during aerodynamic testing). According to Federal Aviation Regulations (FAR Part 25), the approach speed of a commercial aircraft should be 1.3 times the stalling speed. According to the same regulations, the initial safe climb speed is 1.2 times the stalling speed after takeoff.

Estimate both, t**he stalling and the approach speeds** for a large twin-engine, jet aircraft with the following parameters: S= 428 square meters, $C_{l\max}$ = 2.30 (with flaps down 30 degrees in the **landing configuration**), landing mass of 250,000 kg (the maximum allowable landing mass) and landing at sea level ISA atmospheric conditions. Note that all speeds calculated using this method are true airspeeds (TAS).

a) Repeat the analysis for landing mass of 230,000 and 210,000 kilograms. Plot the trend of landing speeds asa function of landing mass.

b) Find the approach speed when the aircraft lands at Mexico City International airport (~7300 feet above sea level conditions). Comment on the difference of approach speed at sea level and in Mexico City.

c) If the same aircraft has a maximum lift coefficient $C_{l\max}$ of 1.65 (with flaps down 10 degrees in the takeoff configuration), find the **initial safe climb speed** at the maximum takeoff mass of 270,000 kilograms. Repeat for values of takeoff mass of 240,000 and 250,000 kilograms. Comment on the changes to takeoff speed with changing mass.