Assignment 5: Air Transportation Systems Analysis

Date Due: October 6, 2014 Instructor: Trani

Problem 1

For the new generation long-range transport aircraft provided in the class web site (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing787_class.m) to answer the following questions.

a) Use the **unrestrictedClimbAnalysis.m Matlab script** to estimate the mass of the aircraft at the Top of Climb (TOC) point. The aircraft OEW is 117,700 kg., 80,000 kg. of fuel and 26,000 kg of payload (passengers and belly cargo). The pilot climbs to 37,000 feet restricted by Air Traffic Control. Use the default climb speed profile provided in the aircraft data file. Use ISA atmospheric conditions in your calculations. The departure airport is Los Angeles International Airport.
b) The aircraft flies a Great Circle Route from LAX to Auckland (New Zealand) at 37000 feet (initially) at Mach 0.83. If the airline and the aircraft are certified to fly 180 minute ETOPS operations. Is the aircraft allowed to file a flight plan that follows a great circle route? Comment.
c) The aircraft has an engine failure while flying at 37,000 feet at a sport located 2,000 nm from LAX at latitude/longitude coordinates (~11 degrees latitude North and 145 degrees West). The following alternate airports are programmed in the flight management computer before departure.

Table 1. Possible Alternate Airports for Problem #1

Airport	Distance from Engine Failure Point (nm)
Hilo	1120
Los Angeles	2000
Pape'ete	1350

d) Estimate the best altitude and cruise speed to continue to an alternate airport. Consider the lost of the engine in your analysis.

e) Using the speed and altitude selected in (d) fly the aircraft to the best alternate airport. Does the 180 minute rule works for this flight?

f) Estimate the final fuel remaining at the alternate airport.

Problem 2

On a busy day, Chicago O'Hare airport approach control uses holding patterns many aircraft to hold aircraft at navigational fixes near airports. The typical holding patterns is flown as a 4-minute maneuver with one minute per side and one minute in the 180-degree turns (see Figure 1). On a busy day, the controller instructs a pilot flying a long-range wide-body aircraft (like the Boeing 787 class vehicle provided in the class notes) to fly the pattern at 10,000 feet and 230 knots (IAS).

a) Estimate the fuel burn consumed in the 4-minute holding pattern for the aircraft in question.

b) Estimate the thrust setting (how much thrust is needed to keep the aircraft in steady and level flight) on both the straight and the turning segments of the holding pattern.

c) Find the radius of the turn for the aircraft flying the holding pattern.

d) What is the bank angle (in degrees) to fly the holding pattern?

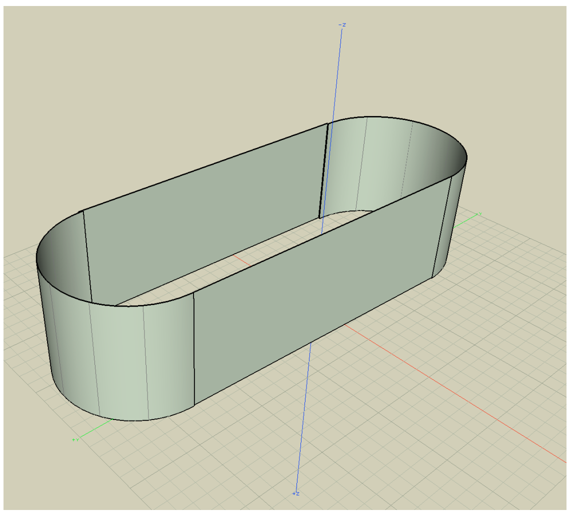

Figure 1. Sample 3D view of a Holding Pattern near an Airport.

Problem 3

Read Chapter 1 of the Instrument Procedures Handbook (http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/instrument_procedures_handbook/). Briefly answer the following:

a) Define what is required navigation performance (RNP).
b) What is the typical RNP in the enroute and terminal airspace today in the NAS?
c) Define what is a Standard Terminal Departure procedure.

Problem 4

Read the paper about CDA approaches by Richard Coppenbarger et al. (Journal of Aircraft, Volume 46, 2009) (http://www.aviationsystemsdivision.arc.nasa.gov/publications/2009/AIAA-39795-675.pdf) and comment on the possible fuel savings reported in the literature using Continuous Descent Approaches.