Assignment 5: Air Transportation Systems Analysis

Date Due: October 16, 2012 Instructor: Trani

Problem 1

Use the four-engine very large capacity transport aircraft performance file provided in the Matlab files for CEE 5614 (http://128.173.204.63/courses/cee5614/cee5614_pub/AirbusA380_class.m) to answer the following questions.

An airline wants to fly the route Bangkok-London with the aircraft. The route is 5,960 nm in Great Circle Distance (see Figure 1). Add 5% to account for route deviations and weather. The aircraft takeoff weight is projected to be 540,000 kgs. with OEW of 260,000 kg., 200,000 kg. of fuel and 80,000 kg of payload.

The aircraft is expected to climb out of Bangkok and reach an initial cruise altitude of 31,000 feet. The pilot wants to fly at Mach 0.83 at that altitude for the first 2.0 hours after reaching the TOC point.

a) Estimate the mass of the aircraft at the point of the first step climb (two hours after reaching the TOC point).

b) Find the best cruise altitude after the 2 hour cruise segment. Provide a minimum of 300 ft/min climb rate at the new altitude in case the aircraft has to maneuver.

c) After completing the climb, the aircraft suffers an engine failure (see point of engine failure in the map). Find the best altitude and speed to cruise with 3 engines.

d) If the aircraft flies over 26,000 feet peaks, if the aircraft able to cruise 2,000 feet above that altitude?

e) Calculate detour times to Katmandu airport (400 nm from the engine failure point) and Gonggar (Tibet) located 260 nm from the point of engine failure.

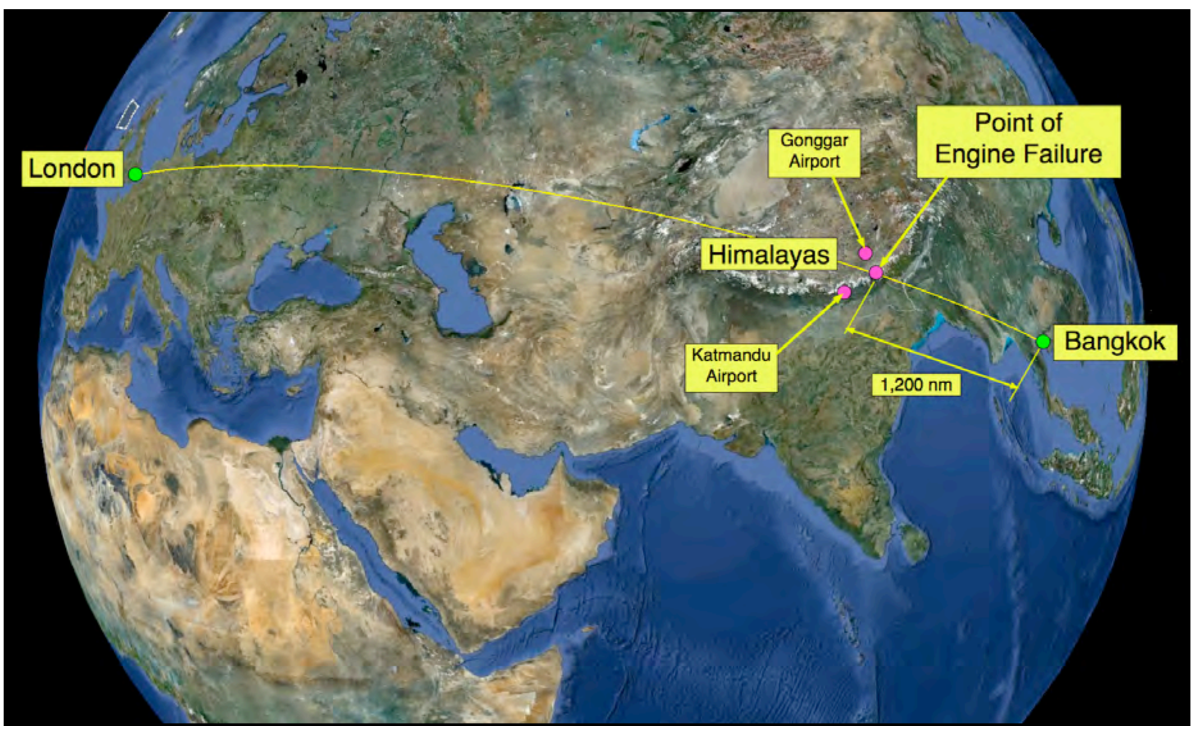

Figure 1. Bangkok-London Route. Source: Google Earth.

Problem 2

Use the large twin-engine transport aircraft performance file provided in the Matlab files for CEE 5614 (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing777_class_2006.m) to answer the following questions.

An airline wants to fly the route ATL-EGLL with the aircraft. The route is 3,660 nm Great Circle Distance (see Figure 2). We can add 5% to account for route deviations. The aircraft takeoff weight is projected to be 270,000 kg. with 140,000 OEW, 80,000 kg. of fuel and 50,000 kg of payload. The aircraft is expected to climb to FL 340 directly and fly at Mach 0.83 at that altitude for 1600 nm after reaching the TOC point. The aircraft reaches the entry point of the North Atlantic Organized Track system (NAT) near Gander, Canada. **Read about the NAT at: http://en.wikipedia.org/wiki/North_Atlantic_Tracks.** Just before entering the NAT the pilot requests FL 370 and Mach 0.83 and continues at that altitude for another 2,000 nm until reaching the Top of Descent Point (TOD) North of London.

a) Calculate the fuel savings to the airline if the aircraft receives an approved flight plan with the step climb before entering the NAT. The baseline scenario is that due to traffic in the NAT Organized Track System (OTS) the aircraft crosses the Atlantic at 34,000 feet.

b) Calculate the additional cost to the airline per flight if the lower altitude is used. The fuel price today in large volumes is $3.10 per gallon of Jet-A fuel.

Figure 2. ATL-EGLL (London) Route.