

CEE 5614: Analysis of Air Transportation Systems
Quiz 1 : Open Notes

Spring 2026

Date Due: March 20, 2026

Instructor: Trani

Instructions

Write your solutions in the spaces provided. Add any additional pages with calculations as needed. Make sure each additional page has your name.

Honor Code Pledge

The information provided in this exam is my own work. I have not received information from another person while doing this exam.

_____ (your signature/name)

Problem 1 40 Points)

Use the new generation twin-engine transport provided in class (Boeing 787-8 class) aircraft provided in class (http://128.173.204.63/cee5614/cee5614_pub/B787_class.m) to answer the following questions.

Simulate a flight using the aircraft departing San Diego Airport (SAN) to Tokyo Narita International Airport (NRT). The aircraft has the following parameters: For the flight, assume the aircraft has 240 seats (assume a 100% load factor) and carries 70,000 kilograms of fuel including fuel reserve.

- a) Use the default climb speed profile provided in the aircraft data file to calculate the fuel burn in climb and the time to climb to an initial altitude that provides at least 500 ft/minute climb rate. Assume ISA atmospheric conditions in your calculations. Remember to round off to the nearest 1000 feet since cruise flight levels are assigned at 1,000 ft increments.
- b) Based on the data provided, estimate the fuel and time used to reach the Top of Climb Point (TOC).
- c) For the cruise segment, the airline dispatch suggests a cruise speed of Mach 0.82 at the altitude selected in part (a). For the selected altitude, estimate the mass of the aircraft at the Top of Climb (TOC) point and the fuel burn (lbs/hr) at the start of the cruise profile.
- d) Estimate the fuel used in cruise assuming the standard 6% detour factor to account for ATC restrictions and weather deviations. For the cruise analysis, use the unrestricted descent profile to estimate the distance from TOD to the destination airport (NRT). Perform the analysis using the following cruise scenarios:
 1. No climb between TOC and TOD (constant altitude).
 2. Schedule multiple climbs throughout the flight so that a climb is requested and granted when the aircraft mass allows the aircraft to climb at a minimum of 500 ft/min at the start of each climb point (see Figure 1). Since the flight is mostly over the Pacific Ocean, assume climbs can be granted at 1,000 foot intervals (with Reduced Vertical Separation Minima).
- e) What is the fuel savings using the multi-climb profile in the route to Japan?
- f) Calculate the additional cost to the airline per flight (between the two profiles estimated in part (b)) if the fuel price today in large volumes is \$2.45 per gallon of Jet-A fuel (<http://www.iata.org/publications/economics/fuel-monitor/Pages/index.aspx>). Comment if the cost differential is significant.

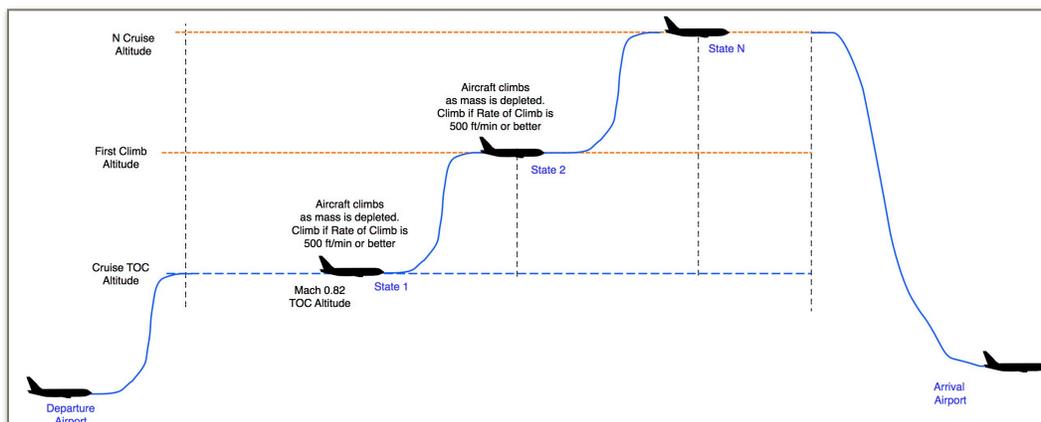


Figure 1. Notional Flight Profile Showing Step Climbs.

Problem 2 (30 Points)

A cargo airline would like to operate a Boeing 747-8F from Querétaro Intercontinental Airport (QRO) during the hottest month of the year.

- a) Find the longest route that can be flown by the aircraft operating at maximum payload conditions for the existing runway length conditions. Clearly indicate the design conditions used (i.e., temperature, elevation and the runway length at the airport).
- b) Find the fuel used and the specific air range for the route found in part (a).
- c) Would you recommend a runway extension for the existing runway? Comment.

Problem 3 (30 Points)

Use the new generation twin-engine transport provided in class (Boeing 787-8 class) aircraft provided in class (http://128.173.204.63/cee5614/cee5614_pub/B787_class.m) to answer the following questions.

- a) Find the thrust required to fly wings level at FL300 (no banking). The aircraft mass is 185,000 kilograms and ATC requests Mach 0.80 (fuel remaining is 35,000 kgs).
- b) Repeat the analysis in part (a) if the aircraft performs a coordinated turn (i.e., no altitude loss) at the standard turn rate. Compare the answers of part (a) and (b).
- c) Find the radius of the turn for condition in part (b).
- d) If the aircraft experiences a depressurization while at in condition (a), find the drift down maneuver to maximize the range.