

## Final Assignment for CEE 4674 (15 Points of Grade per Syllabus)

**Date Due: December 14, 2021 at midnight**

Instructor: Trani

### Instructions:

#### Group assignment (2 people maximum)

Submit a short report with your answers (3-5 pages - in addition to the front page) including figures and sample calculations

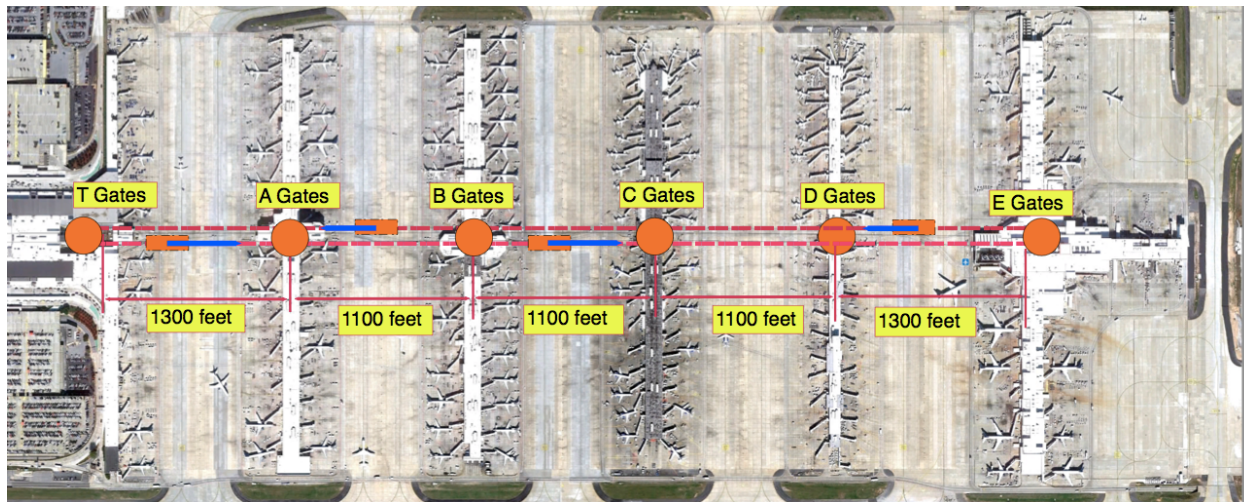
#### Working individually.

Do Problem 1 parts (a-c) and Problem 2 (a-c)

#### Sign VT Honor Code Pledge

### Problem 1

Prior to Covid-19, Atlanta International Airport had a peak demand flow of 10,800 passengers per hour (one-way) traveling from various concourses to the main terminal (see Figure 1). The Bombardier Innovia APM 100 system consists of Transit Units (TU) with four cars holding up to 70 passengers per car (at maximum capacity).



*Figure 1. Atlanta APM System Layout.*

- Estimate and plot the capacity of APM system for headways ranging from 1 to 2 minutes. Estimate the recommended headway to handle the peak load.
- Use the FAA Terminal Area Forecast (TAF) to estimate the future passenger demand (enplanements) at ATL in the year 2045.

- c) Assume the peak passenger flow using the APM system will increase proportionally with the changes in enplanements reflected in the FAA forecast. Find if the ATL APM system will be adequate in 2045. State any changes you may recommend to satisfy the passenger needs at the airport.

## Problem 2

a) Estimate the Day-Night Average Noise Level - DNL (or LDN) for three locations (A,B, and C) shown in Figure 2. The points of interest are located underneath the flight path of runway 27R. Runway 27R is only used for arrivals at the airport. For this problem assume the noise contribution of arrivals two runway 27L and 28C can be ignored to simplify the problem. Runway 27R is mostly used by regional aircraft such as the Embraer 145 and narrow-body aircraft represented by the Boeing 737-700. The Sound Exposure Level data is provided in class. The glide slope to runway 27R is three degrees according to the ILS approach procedure. In your calculations, assume aircraft touchdown ~1,000 ft from the runway threshold.

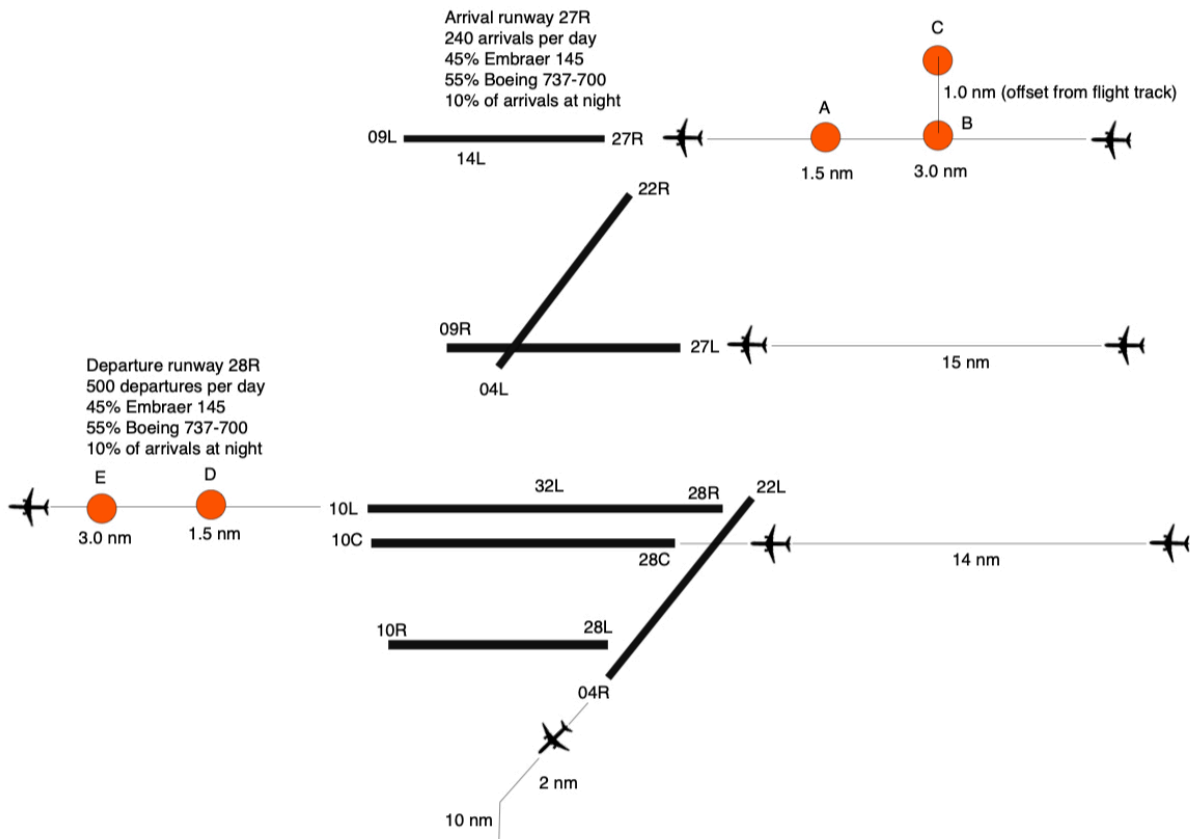


Figure 2. Chicago ORD Airport Configuration. Westflow Configuration.

- Explain the type of compatible land uses that you could expect at locations A, B and C based on the DNL noise levels calculated.
- Estimate the percent of the US population that will be annoyed at locations A, B, and C. Use the US average response survey published by the FAA.
- Estimate the Day-Night Average Noise Level - DNL (or LDN) for departure runway 28R at locations (D and E) shown in Figure 2. Assume the aircraft fly departure profiles at 170 knots and with typical climb rates of 2,400 feet/minute. Boeing 737-700 and E145 typically use 7,500 feet of runway while departing runway 28R.
- Compare the arrival DNL with departure DNL levels.

Aircraft Sound Exposure Level Data (Source: FAA Integrated Noise Model and AEDT 3d Model)

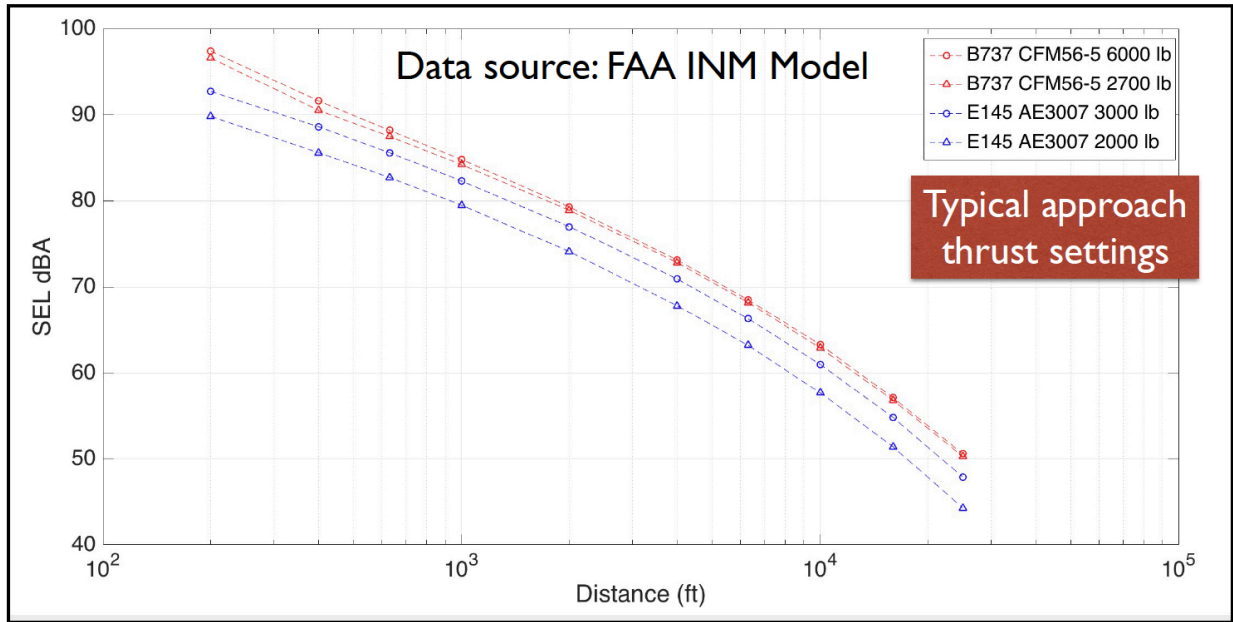


Figure 3. Approach Sound Exposure Level Data for Boeing 737-700 and Embraer 145.

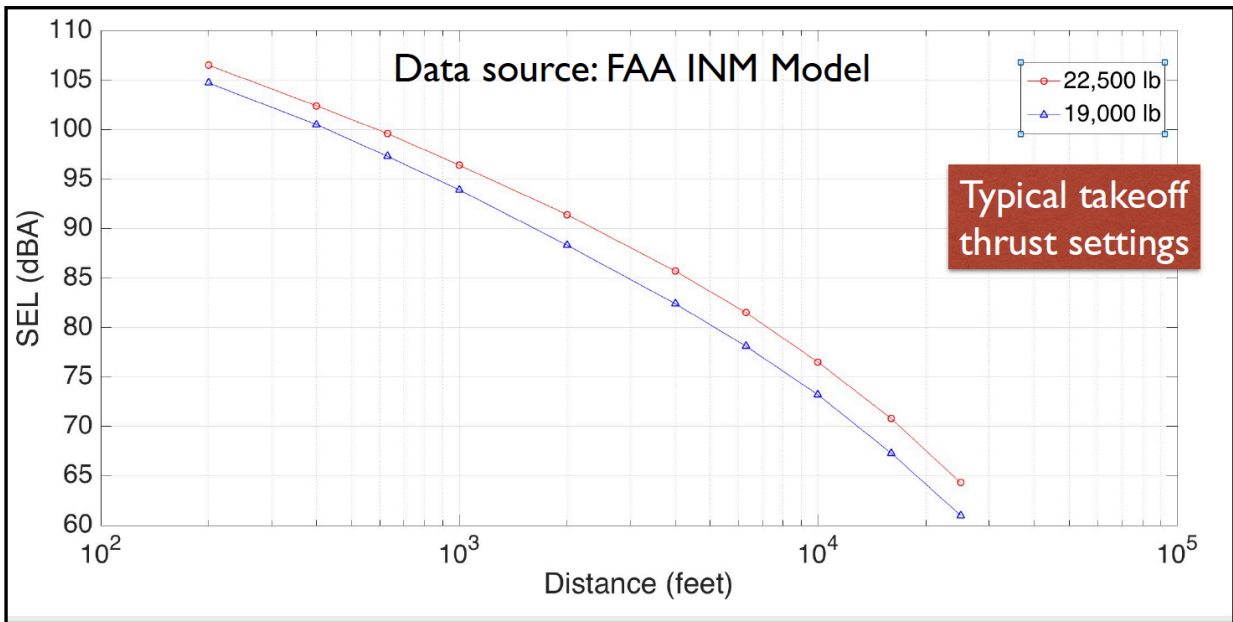


Figure 4. Takeoff (Departure) Sound Exposure Level Data for Boeing 737-700 with CFM565 Engines.

*Table 1. Sound Exposure Level Data for Embraer 145 Aircraft. Departure Operation with 6,000 lbs. of Thrust per Engine (Takeoff Thrust). Rolls-Royce AE3007 Engine.*

<b>Distance (feet)</b>	<b>SEL Level (dBA)</b>
200	96.7
400	93.0
630	90.3
1000	87.5
2000	82.8
4000	77.2
6300	72.8
10000	67.7
16000	61.6
25000	54.9

*Table 2. Sound Exposure Level Data for Embraer 145 Aircraft. Arrival with 3,000 lbs. of Thrust per Engine (Approach Thrust). Rolls-Royce AE3007 Engine.*

<b>Distance (feet)</b>	<b>SEL Level (dBA)</b>
200	92.7
400	88.6
630	85.6
1000	82.3
2000	77.0
4000	70.9
6300	66.3
10000	61.0
16000	54.8
25000	47.9

*Table 3. Sound Exposure Level Data for Boeing 737-700 Aircraft with CFM565 Engine. Departure Operation with 22,500 lbs. of Thrust per Engine (Takeoff Thrust).*

<b>Distance (feet)</b>	<b>SEL Level (dBA)</b>
200	106.5
400	102.4
630	99.6
1000	96.4
2000	91.4
4000	85.7
6300	81.5
10000	76.5
16000	70.8
25000	64.3

*Table 4. Sound Exposure Level Data for Boeing 737-700 Aircraft with CFM565 Engine. Arrival Operation Thrust Level (6,000 lbs of thrust).*

<b>Distance (feet)</b>	<b>SEL Level (dBA)</b>
200	97.4
400	91.6
630	88.2
1000	84.8
2000	79.3
4000	73.1
6300	68.5
10000	63.3
16000	57.1
25000	50.6