CEE 4674 Final Project / Exam

Airport Planning and Design

Open Book and Notes (Take Home - Groups of 2)

Your Name _____

VT Number _____

Signatures * _____

* The answers in this exam are the product of our own work. I certify that I have not received nor I have provided help to others while taking this examination.

Directions:

Solve the problems. Start a new page in every problem solution. When the exam is completed, print the exam and bring it to the final exam room. Write your name in every page just in case. Due date is May 9, 2014. (during the final exam week).

Prepare a 8-10 page summary report with figures supporting your answers to the 2 problems included in the exam. Include figure legends, references and page numbers. All supporting calculations can be included in an appendix. The appendix does not count towards the page limit. Make sure to include page numbers in your presentation and in your final report.

Prepare a 15 minute powerpoint presentation to explain both problem solutions and be ready to present (as a group) in the final exam date. This presentation should be a collaborative effort (2 people presenting).

Show all your work.

Problem 1

Table 1 illustrates the typical aircraft fleet mix operating at LAX Airport in the typical day. This aircraft mix will be used to estimate the noise contours and the capacity of the airport. In the typical day of the year 2013, the airport handled **1,840 operations daily**. Half of them arrivals and the other half departures.

Table 1. LAX Fleet Mix and INM Aircraft to be Used in the Study.

Aircraft	% Fleet Mix in 2020	INM Aircraft to Use	Wake Class
Embraer 120	14	EMB120	Small
B737 (600-900)	29	737700	Large
747-8/A380	4	747400	Super-heavy
B767 and B757	19	767CF6	Heavy
A320 (318-321)	13	A320-232	Large
CRJ (200-900)	5	CL601	Large
B777 (200-300)	16	777300	Heavy
Total	100		

Figure 1. West-flow Operations at LAX Airport. Runways 24R and 25L used for Arrivals. Runways 25R and 24L used for Departures.

Using the arrival-arrival and departure-departure separation matrices shown in Tables 2 and 3, determine the saturation capacity of the airport for West Flow operations. Assume the ROT values at the airport for 4 wake classes are: 52 (small), 56 (large), 63 (Heavy) and 83 (Superheavy) seconds. For both IFR and VFR conditions, the airport operates arrivals on runways 24R and 25L. Departures on 24L and 25R. The approach speeds (in knots) derived from radar data are: 127 (small), 138 (large), 152 (Heavy) and 152 (Superheavy). The airport has the following technical

parameters: a) in-trail delivery error of 14 seconds, b) departure-arrival separation for both VMC and IMC conditions is 2 nautical miles, c) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the final approach fix located 7 miles from the runway threshold.

Table 2. Arrival-Arrival Separation Matrix. VFR Conditions.

Minimum Separation Matrix (nm)		Arrivals-Arrivals			
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	2.5	2.5	2.5	2.5	2.5
Large	4	3	2.5	2.5	2.5
B757	5	4	3	3	2.5
Heavy	6	5	4	4	4
Superheavy	10	10	10	10	10

Table 3. Departure-Departure Separation Matrix. VFR Conditions.

Departure-Departure Separation Matrix (seconds)					
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	60	60	60	60	60
Large	90	60	60	60	60
B757	120	120	60	60	60
Heavy	120	120	120	120	90
Superheavy	150	120	120	120	120

a) **Plot the complete Pareto capacity diagram for VFR conditions at the airport. Label appropriately.**

b) **Estimate the benefit of using the natural gaps between successive arrivals on runways 24R and 25L to accommodate a few more departures at the airport. Quantify the number of departures on 24R and 25L maintaining 100% arrival priority on 24R and 25L. Explain what are the possible drawbacks of allowing departures on the outer runways.**

Problem 2

Perform a noise study for the LAX airport considering the fleet mix shown presented in Table 1. The arrival and departure flow patterns are shown in Figure 2. Assume that the distribution of arrivals (4 arrival tracks) is as follows: 20% on arrival track 1, 25% on arrival track 2, 15% on arrival track 3 and 40% on arrival track 4. Assume that arrival tracks 3 and 1 follow the same pattern North of their split point. The departure traffic is 50% departures on runway 24L and 50% on runway 25L. Of the departures from 24L, assign 60% to the North branch departing traffic to departure track 1 and 40% to departure track 2.

Figure 2. Simplified Arrival and Departure Patterns to LAX.

a) Find the noise contours around the airport from 55-80 LDN. Plot using your CAD and INM skills. Export the noise contours to a DXF file and then read the file using Autocad or equivalent application.

b) Estimate the area under the 55 and 65 LDN contours.

c) Suggest improvements to reduce the noise at this airport.

Bonus: Export the contours to Google Earth and superimpose the contours exported as an Image Overlay (or layer) of the Google Earth satellite picture.