

**SULIT**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2011/2012**

COURSE NAME : INTRODUCTION TO AIRCRAFT  
COURSE CODE : BDU 10202  
PROGRAM : 1 BDC, 1 BDM  
EXAMINATION DATE : JANUARY 2012  
DURATION : 2 HOURS  
INSTRUCTION : **PART A: ANSWER ONE (1)  
QUESTION ONLY**  
**PART B: ANSWER ALL  
QUESTIONS**

THIS PAPER CONSISTS OF SEVEN (7) PRINTED PAGES

**SULIT**

**PART A : ANSWER ONE (1) QUESTION ONLY.**

**Q1** The full specifications of Airbus 380-800 are shown in **Table Q1**. Based on the given specs:

- a) Compute the minimum takeoff speed, the runway length and the time needed to takeoff if the airplane is going to operate in Malaysia. Take  $\mu=0.01$ ;  $C_L$  and  $C_D$  at takeoff flap configuration as 3.22 and 0.34 respectively  
(25 marks)
- b) Does Kuala Lumpur International Airport ready to accept the operation of Airbus 380-800 now since its runway is only 13,530ft (4,124m) long?  
(5 marks)
- c) Analyze the above factors in cases of the airplane operating in Saudi Arabia and Toronto Canada where the extreme temperature may reach  $41^{\circ}\text{C}$  ( $\mu = 0.01$ ,  $\rho = 0.913 \text{ kg/m}^3$ ) and  $-10^{\circ}\text{C}$  ( $\mu = 0.005$ ,  $\rho = 1.537 \text{ kg/m}^3$ ) respectively.  
(16 marks)
- d) Comment on the suitability of operating this type of aircraft world wide.  
(4 marks)

**Q2** The maiden flight for UTHM's Learjet is scheduled from Tanjong Laboh Airport in December 2013. **Table Q2** illustrates the aircraft specifications. Based on the given information:

- a) Briefly differentiate between service ceiling and absolute ceiling.  
(5 marks)
- b) For the Learjet, using the maximum typical cruising speed, plot a graph or construct a table of Lift produce versus various Air Densities.  
[Cruise Configuration:  $C_L=0.71$  and use standard basic operation weight]

(15 marks)

- c) By using the plot/table estimate the absolute ceiling for the aircraft. Are these values the equal for all aircrafts that fly in the sky?

(10 marks)

- d) Calculate the percentage different between the absolute and service ceilings for the Learjet. Does this percentage different is the same for all aircraft? Please explain.

(10 marks)

- e) To fly at 4,000m altitude at a constant cruising speed, what is the percentage power setting needed? Take  $C_D = 0.071$ .

(10 marks)

**PART B : ANSWER ALL QUESTIONS.**

**Q3** Several aircraft have retractable landing gears while others have non-retractable landing gears.

- a) Give one example of aircraft for each type of landing gear. Sketch and briefly explain the working principle of both types of landing gears.

(10 marks)

- b) Establish the reasons for having these types of landing gear.

(5 marks)

- c) With the help of a diagram briefly outline the brake system for a non-retractable landing gear. State also the type of brake fluid used.

(10 marks)

**Q4** There are various types of clouds in the sky.

a) Name three (3) types of clouds and state at what height each type exists?

(6 marks)

b) Determine two types of cloud that are dangerous to flying activities and justify your selections?

(6 marks)

c) Explain why some aircraft are permissible and some are not permissible to fly through the dangerous cloud? Explanation should be accompanied by an appropriate diagram.

(13 marks)

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TABLE Q1

AIRBUS A380 SPECS		
Measurement	A380-800	A380-800F
Cockpit crew	Two	
Seating capacity	525 (3-class)	12 couriers
	644 (2-class)	
	853 (1-class)	
Length overall	72.73 m (238.6 ft)	
Wingspan	79.75 m (261.6 ft)	
Height	24.45 m (80.2 ft)	
Wheelbase	33.58 m (110.2 ft) wing landing gear	
	36.85 m (120.9 ft) body landing gear	
Wheel track	12.46 m (40.9 ft)	
Outside fuselage width	7.14 m (23.4 ft)	
Outside fuselage height	8.41 m (27.6 ft)	
Maximum cabin width	6.58 m (21.6 ft) Main deck	
	5.92 m (19.4 ft) Upper deck (floor level)	
Cabin length	49.9 m (164 ft) Main deck	
	44.93 m (147.4 ft) Upper deck	
Wing area	845 m <sup>2</sup> (9,100 sq ft)	
Aspect ratio	7.5	
Wing sweep	33.5°	
Maximum taxi/ramp weight	571,000 kg (1,260,000 lb)	592,000 kg (1,310,000 lb)
Maximum take-off weight	569,000 kg (1,250,000 lb)	590,000 kg (1,300,000 lb)
Maximum landing weight	391,000 kg (860,000 lb)	427,000 kg (940,000 lb)
Maximum zero fuel weight	366,000 kg (810,000 lb)	402,000 kg (890,000 lb)
Typical Operating empty weight	276,800 kg (610,000 lb)	252,200 kg (556,000 lb)
Maximum structural payload	89,200 kg (197,000 lb)	149,800 kg (330,000 lb)
Maximum cargo volume	176 m <sup>3</sup> (6,200 cu ft)	1,134 m <sup>3</sup> (40,000 cu ft)
Maximum operating speed	Mach 0.89	
at cruise altitude	(945 km/h, 587 mph, 510 knots)	
Maximum design speed	Mach 0.96	
in dive at cruise altitude	(at cruise altitude: 1020 km/h, 634 mph, 551 knots)	
Take off run at MTOW/SL ISA	2,750 m (9,020 ft)	2,900 m (9,500 ft)
Range at design load	15,400 km (8,300 nmi, 9,500 mi)	10,400 km (5,600 nmi, 6,400 mi)
Service ceiling	13,115 m (43,028 ft)	
Maximum fuel capacity	323,546 L	310,000 L
	(85,472 US gal)	(81,893 US gal),
		323,546 L
Engines (4 x)	GP7270 (A380-861)	GP7277 (A380-863F)
	Trent 970/B (A380-841)	Trent 977/B (A380-843F)
	Trent 972/B (A380-842)	
Thrust (4 x)	310 kN (70,000 lbf) – GP7270	340 kN (76,000 lbf) – GP7277
	310 kN (70,000 lbf) – Trent 970/B	340 kN (76,000 lbf) – Trent 977/B
	320 kN (72,000 lbf) – Trent 972/B	

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TABLE Q2

## LEARJET TECHNICAL SPEC

General	Performance	Approximate Dimensions																																																																																										
<p><b>Capacity:</b> 2 Crews + 10 passengers</p> <p><b>Engines</b> PW307B Pratt &amp; Whitney (Twin Engines) <b>Turbofans Thrust:</b> 6,100 lb (27.13 kN) <b>Flat Rated To:</b> ISA + 15°C (86°F)</p>	<p><b>Range</b> <b>Maximum Range (±5%):</b> 3,000 NM (5,556 km)</p> <p><b>Speed</b></p> <table border="0"> <tr> <td></td> <td><b>Mach</b></td> <td><b>kt</b></td> <td><b>mph</b></td> <td><b>km/h</b></td> </tr> <tr> <td><b>Max</b></td> <td>0.82</td> <td>470</td> <td>541</td> <td>871</td> </tr> <tr> <td><b>Operating</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><b>Speed</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><b>Typical</b></td> <td>0.80</td> <td>459</td> <td>528</td> <td>850</td> </tr> <tr> <td><b>Cruise</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><b>Speed (±3%)</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="5"><i>(at 41,000 ft, 31,200 lb cruise weight, standard ISA conditions)</i></td> </tr> <tr> <td><b>Long-Range</b></td> <td>0.78</td> <td>447</td> <td>515</td> <td>829</td> </tr> <tr> <td><b>Speed</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><b>(±3%)</b></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="5"><i>(at 45,000 ft, 31,200 lb cruise weight, standard ISA conditions)</i></td> </tr> <tr> <td colspan="5"><b>Airfield Performance</b></td> </tr> <tr> <td colspan="5"><b>Takeoff Distance (±5%):</b> 4,800 ft 1,463 m <i>(SL, ISA, MTOW. Field lengths are based on a level hard surface, dry paved runway with zero wind.)</i></td> </tr> <tr> <td colspan="5"><b>Landing Distance (±5%):</b> 2,700 ft <i>(SL, ISA, MLW, 14CFR 91. Field lengths are based on a level hard surface, dry paved runway with zero wind.)</i></td> </tr> <tr> <td colspan="5"><b>Operating Altitude</b></td> </tr> <tr> <td colspan="5"><b>Maximum Operating Altitude:</b> 49,000 ft (14935 m)</td> </tr> <tr> <td colspan="5"><b>Initial Cruise Ceiling:</b> 43,000 ft <b>(SL, ISA, MTOW)</b> (13,106 m)</td> </tr> </table>		<b>Mach</b>	<b>kt</b>	<b>mph</b>	<b>km/h</b>	<b>Max</b>	0.82	470	541	871	<b>Operating</b>					<b>Speed</b>					<b>Typical</b>	0.80	459	528	850	<b>Cruise</b>					<b>Speed (±3%)</b>					<i>(at 41,000 ft, 31,200 lb cruise weight, standard ISA conditions)</i>					<b>Long-Range</b>	0.78	447	515	829	<b>Speed</b>					<b>(±3%)</b>					<i>(at 45,000 ft, 31,200 lb cruise weight, standard ISA conditions)</i>					<b>Airfield Performance</b>					<b>Takeoff Distance (±5%):</b> 4,800 ft 1,463 m <i>(SL, ISA, MTOW. Field lengths are based on a level hard surface, dry paved runway with zero wind.)</i>					<b>Landing Distance (±5%):</b> 2,700 ft <i>(SL, ISA, MLW, 14CFR 91. Field lengths are based on a level hard surface, dry paved runway with zero wind.)</i>					<b>Operating Altitude</b>					<b>Maximum Operating Altitude:</b> 49,000 ft (14935 m)					<b>Initial Cruise Ceiling:</b> 43,000 ft <b>(SL, ISA, MTOW)</b> (13,106 m)					<p><b>External Dimensions</b> <b>Length:</b> 68.1 ft (20.76 m) <b>Wingspan (approximately):</b> 56.7 ft (17.28 m) <b>Overall Wingspan:</b> 61.5 ft (18.75 m) <b>Wing Area:</b> 401.0 ft<sup>2</sup> (37.25 m<sup>2</sup>) <b>Height Overall:</b> 19.9 ft (6.08 m)</p> <p><b>Weights *</b></p> <p><b>A. Maximum Ramp Weight (±3%) :</b> 36,900 lb (16,733 kg)</p> <p><b>B. Maximum Takeoff Weight (±3%):</b> 36,700 lb (16,682 kg)</p> <p><b>C. Maximum Landing Weight (±3%):</b> 30,150 lb (13,676 kg)</p> <p><b>D. Maximum Zero Fuel Weight (±3%):</b> 26,500 lb (12,046 kg)</p> <p><b>E. Standard Basic Operating Weight (±3%):</b> 23,850 lb (10,841 kg)</p> <p><b>F. Approximate Fuel Capacity (±3%):</b> 12,500 lb (5,682 kg) (usable at 6.75 lb/gal)</p>
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Altitude, km	Temperature, °C	Absolute Pressure, kPa	Specific Weight, N/m <sup>3</sup>	Density, kg/m <sup>3</sup>	Viscosity × 10 <sup>5</sup> , Pa·s
0	15.00	101.33	12.01	1.225	1.789
2	2.00	79.50	9.86	1.007	1.726
4	-11.00	61.64	8.02	0.819	1.661
6	-23.96	47.22	6.46	0.660	1.595
8	-36.94	35.65	5.14	0.526	1.527
10	-49.90	26.50	4.04	0.414	1.458
12	-56.50	19.40	3.05	0.312	1.422
14	-56.50	14.17	2.22	0.228	1.422
16	-56.50	10.35	1.62	0.166	1.422
18	-56.50	7.57	1.19	0.122	1.422
20	-56.50	5.53	0.87	0.089	1.422
22	-54.58	4.05	0.63	0.065	1.432
24	-52.59	2.97	0.46	0.047	1.443
26	-50.61	2.19	0.33	0.034	1.454
28	-48.62	1.62	0.24	0.025	1.465
30	-46.64	1.20	0.18	0.018	1.475