CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FCD 20203
SUBJECT TITLE	:	COOLING LOAD
LEVEL	:	DIPLOMA
TIME / DURATION	:	9.00 am - 12.00 noon (3 HOURS)
DATE	:	0 1 JUN 2014

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.

2. This question paper is printed on both sides of the paper.

3. Please write your answers on the answer booklet provided.

4. Answer should be written in blue or black ink except for sketching, graphic and illustration.

5. This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) questions only.

6. Answer all questions in English.

7. Fomula is appended.

8. Cooling Load Documentation is provided.

THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Figure Q1: Floor Plan

(a)   Referring Figure Q1, employing the Cooling Load Check Figure, calculate the capacity of unit to be installed at Family Hall.

(10 marks)

(b)   By using the answer in question 1(a) and the attached catalogue at Appendix 1, select the suitable unit to be installed at that area. Give at least three (3) reasons for your selection.
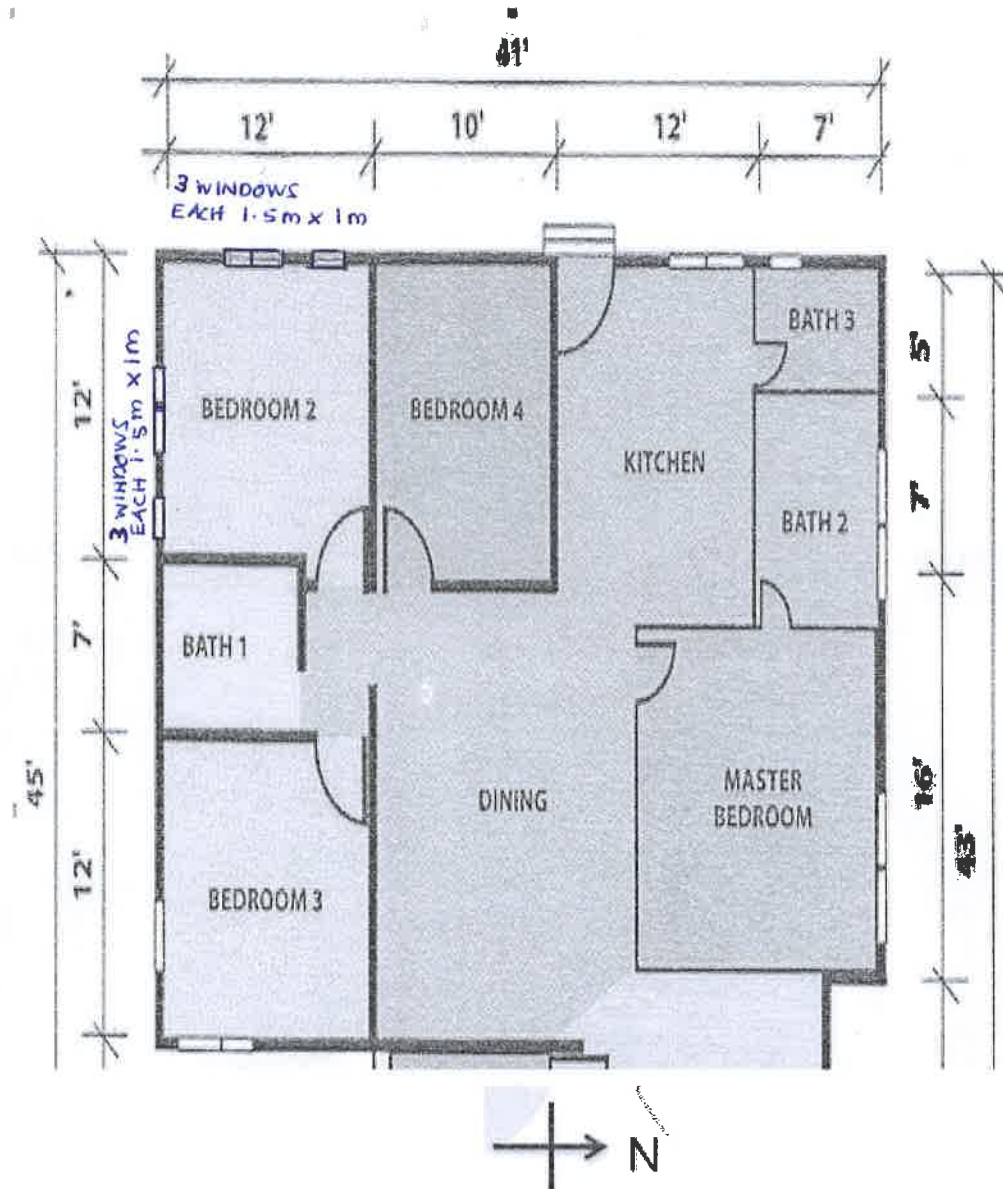
(10 marks)

Question 2

Figure Q2 (a): Single-Storey House

(a)   Referring figure Q2 (a), find the cooling load for Bedroom 2 employing the Daikin Method in Appendix 2.Given that the floor area of Bedroom 2 is 12 ft x 12 ft and its ceiling height is 10 ft.

Specification of construction:
a) Building   : Single-story House
b) Outside wall   : Medium construction (concrete block 150mm thickness)

c) Window glass   : Normal (6mm thickness) with blind
d) Floor   : Concrete with carpet place on the floor
e) Ceiling   : Only concrete
f) Lights   : Fluorescent lights (40w x 2 units)
g) Persons   : 2 (sitting on a chair)
h) Area   : Standard temperature
i) Door   : 1.2m x 2m
j) Window   : 1.5m x 1m

Assume that, Bedroom 4 is already cooled.

(15 marks)

(b)   By using the answer in Question 2(a) and the attached catalogue in Appendix 1, select the suitable unit to be installed at that area.
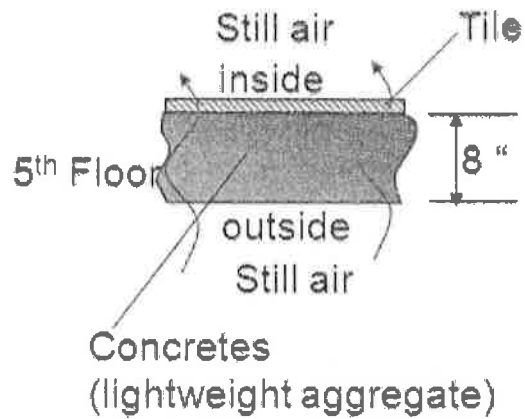
(5 marks)

Question 3

Figure Q3 (a): Heat Transfer in the Building

(a)   Referring Figure Q3 (a), calculate the Total Thermal Resistance $\sum R$ in ft^2.hr.F/Btu. Given that the surface emittance is 0.9.
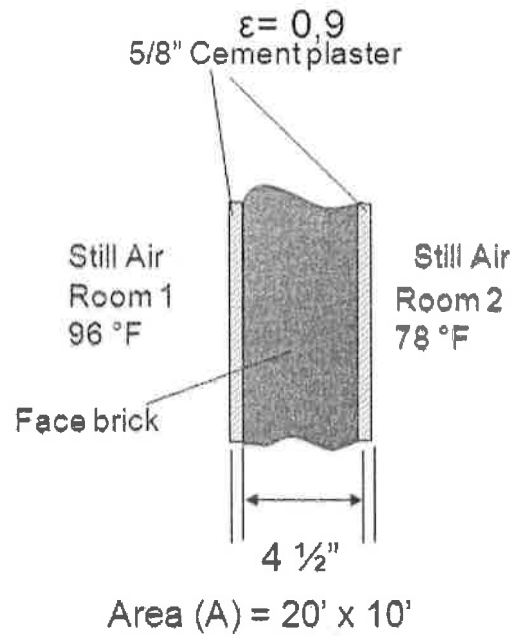
(8 marks)

Figure Q3 (b): Heat Transfer thru Wall

(b)   Referring Figure Q3 (b), determine:

i.   Total Thermal Resistance, $\sum R$ in ft2.hr.F/Btu

(7 marks)

ii.   Overall heat transfer coefficient, U in Btu/ft2.hr.F

(2 marks)

iii.   Heat Loss, q in Btu/hr

(3 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO questions.

Please use the answer booklet provided.

Question 4

(a)   Determine solar azimuth at 16:30 on 21.02.2014 in Johor Bahru. Given that, the solar time, Tsol is 14:41:42.

(10 marks)

(b)   Determine the hourly instantaneous sensible load from the occupants in the conditioned space at 9 am, 10 am and 1pm .Knowing that the building is designed for office use and houses for 75 occupants from 8 am to 4 pm. For most occupied period, the occupants are expected to be seated and performing office work.

(10 marks)

Question 5

(a)   By using the below data, determine:

Building	: Vertical, facing South West
Location	: Bandar Baru Bangi,Malaysia.
Date	: 21st October 2014
Solar Altitude	: 36.16°
Wall Solar Azimuth	: 29.93°

i.   Angle of Incidence,θ

(5 marks)

ii.   Direct Normal Radiation,Gnd

(5 marks)

(b)   Calculate the hourly instantaneous sensible load of the conditioned space (occupied from 8 am to 4 pm) due to the office equipment at 9 am, 12 pm and 1 pm. The heat gained from the office equipment is 6.0 w/ft^2.The floor areas for this space are 3000ft^2.

(10 marks)

Question 6

(a)   Find the solar altitude at Kota Kinabalu on the 21st May 2014. The standard time is 14:30.

(10 marks)

(b)   Knowing that the heat gained from the office equipment is 5.0 W/ft^2 and the floor area for that space is 2500 ft^2. Determine the hourly instantaneous sensible load of the conditioned space which occupied from 8 am to 4 pm due to the office equipment at 10 am, 1 pm and 3 pm.

(10 marks)

END OF QUESTION

Appendix 1 : Catalogue

Healthy Series Specifications

SPECIFICATIONS

MODEL	INDOOR UNIT		YWM 09G	YWM 10G	YWM 15G	YWM 20G		YWM 25G	
	OUTDOOR UNIT		YSL 09C	YSL 10C	YSL 15C	YSL 18C	YSL 20C	YSL 20C	YSL 25C
TYPE	ESSENTIAL		YWM09G (Ess)	YWM10G (Ess)	YWM15G (Ess)	YWM20G (Ess)	YWM20G (Ess)	YWM25G (Ess)	YWM25G (Ess)
	ION-AIR		YWM09G (ION)	YWM10G (ION)	YWM15G (ION)	YWM20G (ION)	YWM20G (ION)	YWM25G (ION)	YWM25G (ION)
TOTAL COOLING CAPACITY		Btu/h	9000	10000	13000	18000	19500	21000	24000
		W	2640	2930	3810	5275	5715	6155	7035
TOTAL POWER		W	880	877	1160	1747	2001	2020	2730
TOTAL CURRENT		A	3.88	3.7	5.09	7.73	8.9	8.92	13.18
POWER SOURCE		V/Ph/Hz	220 - 240 / 1 / 50						
INDOOR UNIT	AIR FLOW	cmm/cfm	7.79 / 275	8.78 / 310	9.77 / 345	14.44 / 510		18.41 / 650	
	DIMENSION HEIGHT	mm	260	260		304			
	DIMENSION WIDTH	mm	799	899		1062			
	DIMENSION DEPTH	mm	198	198		222			
	WEIGHT	kg	10	12		16			
	CONTROLLER TYPE		LCD REMOTE CONTROLLER						
	CONDENSATE DRAIN SIZE	mm	16			20			
	AIR FILTER Essential		SARANET						
	AIR FILTER ION-AIR		SARANET + ANTI MICROBIAL + TITANIUM OXIDE						
	AIR TREATMENT Essential								
	AIR TREATMENT ION-AIR		NEGATIVE IONS						
OUTDOOR UNIT	AIR FLOW	cmm/cfm	18.4 / 650	24.4 / 860	27.5 / 970	34.0 / 1200	38.0 / 1340		42.5 / 1500
	DIMENSION HEIGHT	mm	495	540		648			750
	DIMENSION WIDTH	mm	600	700		855			855
	DIMENSION DEPTH	mm	245	250		328			328
	WEIGHT	kg	28	32		57	59		62
PIPE	TYPE		FLARE						
	SIZE LIQUID	mm/in	6.35 / 1/4						9.52 / 3/8
	SIZE GAS	mm/in	9.52 / 3/8		12.7 / 1/2	15.88 / 5/8			
REFRIGERANT TYPE & CONTROL			R22 / CAPILLARY TUBE (OUTDOOR)						

• All specifications are subjected to change by the manufacturer without prior notice.

• All units are being tested and comply to ARI 210 / 240.

• YWM 10G is ordered based on project basis only.

Appendix 2 : Daikin Table (Must be return with answer booklet)

			Date :	
Company:		Name of person		
Address:		in charge		
Name of room		Room area (W)		m²
Floor :		Room Volume :(Area)		m³

Items			A		Cooling			
					coef B	C = A x B	coef.f	Load Q = f X C
Wall faced to the outdoor			m³					
			m³				1	
			m³					
			m³					
			m³					
Roof		AREA	m³					
Window glass			m³			Content of heat		
			m³					
			m³					
			m³					
Partition			m³					
			m³					
			m³				1	
Ceiling			m³					
Floor			m³					
Outdoor air	Invasion of outdoor air	Room Vol.	m³				Area corr.1.0	
Heat generation in the room	Person	Number					1	
	Light	Electric light	kw	860		Rate of using	1	
		Fluorescant light	kw	1000			1	
	Electric apparatus		kw	860			1	
			kw	860			1	
	SH	equipment		m³/h				
		person		m³/h				
btu/h = kcal/hr x 3,97		Total cooling load (kcal/hr)						
								0,7
		Total cooling load in btu/hr						

Appendix 3 : Formula:

- $1 ft = 12 inch$
- $1 m = 3.28 ft$
- $1 hr = 15°$
- $1° = 60'$
- $R = 1/c$ or $\Delta x/k$ where $\Delta x = thickness$
- $U = 1/R$ or $1/\sum R$
- $Q = UA\,\Delta T$
- $t_{sol} = t_{std} - (L_{std} - L_{loc})\, 4min/° + E_t$
- $H = t_{sol} - 12:00$
- $\sin \beta = \cos l \cos h \cos d + \sin l \sin d$
- $\cos \phi = (\sin \beta \sin l - \sin d) / (\cos \beta \cos l)$
- $\gamma = \phi \pm \psi$
- $\cos \theta = \cos \beta \cos \gamma \sin \alpha + \sin \beta \cos \alpha$
- $G_{ND} = A/e^{(B/\sin \beta)}$
- $G_D = G_{ND}\cos\theta$
- $G_R = G_{th}\, \rho\, Fwg$
- $Fwg = (1 - \cos \sum)/2$, where $\sum = 90 - \alpha$ ($\alpha = 0$ for horizontal)
- $Gd = (C)(G_{ND})$
- $Gt = GD + Gd + GR$ or $Gt = GD + Gd$
- $L_{std} = 120°E$
- $Bangi = L_{loc} = 101° 48'E, l = 2° 56'N$
- $Pulau\ Pinang = L_{loc} = 100° 38'E$
- $Johor\ Bahru = L_{loc} = 103° 55'E, l = 1° 28'N$
- $Kuching = L_{loc} = 110° 19'E, l = 1° 28'N$
- $Kota\ Bahru = L_{loc} = 102° 15'E, l = 7° 48'N$
- $Kota\ Kinabalu = L_{loc} = 116° 05'E, l = 5° 59'N$
- $Malacca = L_{loc} = 102° 18'E$
- $Q\ wall = U \times A \times CLTD\ corr$
- $Q\ roof = U \times A \times CLTD\ corr$
- $CLTD\ corr = (((CLTD + Lm) \times 5/9) \times K) + (25.5\,°C - Ti) + (To - 29.4\,°C)$
- $Lm = Correction\ Latitude$
- $K = Correction\ of\ color, black = 1, light\ color = 0.5$
- $Ti = Inside\ temperature$
- $°F\ to\ °K = multiply\ by\ 5/9$
- $English\ to\ S.I\ unit\ (U\ value) = multiply\ by\ 5.678\ (W/m^2.K)/(Btu/hr.ft^2.F)$
- $To = Outdoor\ Temperature - (RH \times Temperature\ Range)$
- $Q\ cond = U \times A \times CLTDcorr$
- $CLTDcorr = (CLTD \times 5/9) + (25.5\,°C - Ti) + (To - 29.4\,°C)$
- $Q\ sol = A \times SC \times SHGF \times CLF$
- $Qapp = A \times q\ appl \times CLF$
- $Q\ light = A \times q\ light \times CLF$
- $Q\ occ = No.of\ Occupants \times q\ occ \times CLF$