



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2011 SESSION

SUBJECT CODE : FCD 20203
SUBJECT TITLE : COOLING LOAD
LEVEL : DIPLOMA
TIME / DURATION : 9.00am – 12.00pm
(3 HOURS)
DATE : 10 MAY 2011

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. Formula is appended.
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THERE ARE 5 PAGES OF QUESTIONS AND 2 PAGES OF APPENDIX, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

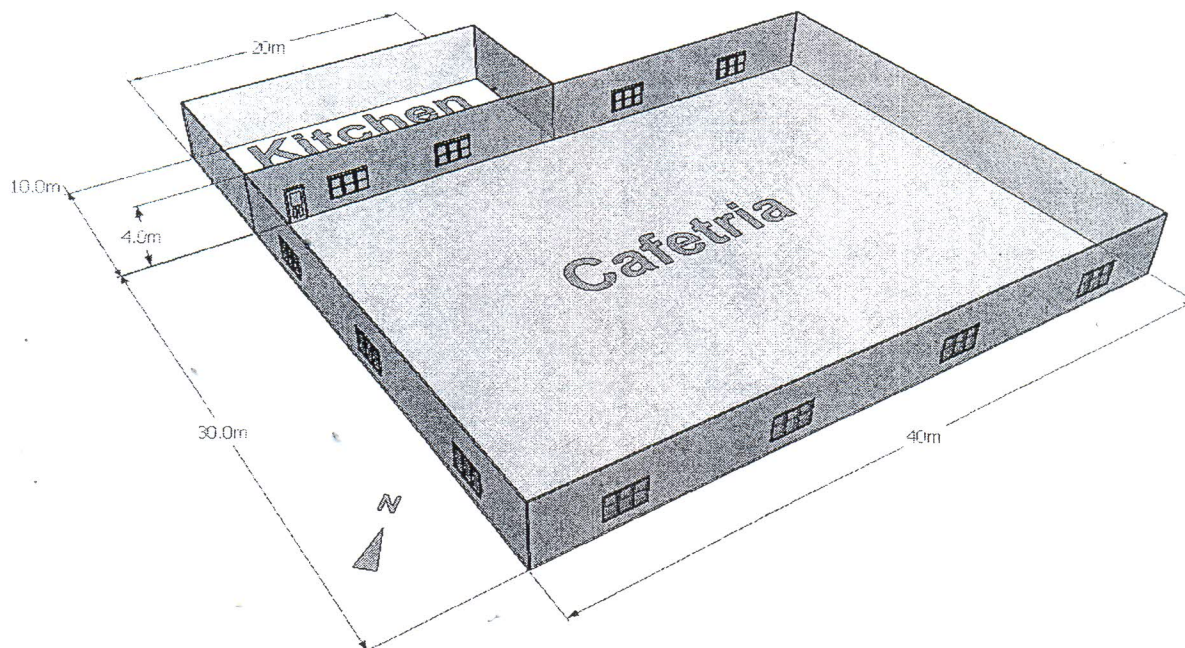


Figure Q1: Cafeteria Ground Floor

- (a) Figure Q1 is shows the ground floor of a cafeteria with outside walls having medium construction. The ceiling height is 4.0 m. All windows are internally shielded with blinds normal glass plate (6 mm thickness).Floor and ceiling only concrete. The window size is 1.0m x 2.0m and the door size is 1.0m x 1.5m.Knowing that there are 6 employees doing office working and 150 customers are sitting on chairs. Inside the cafeteria 25 numbers of 80 watt electrical light and total loads for fluorescent light are 7500 watt. There also got food warmer with capacity of 240 watt and freezer 810 watt. Calculate the total cooling load for this cafeteria by using Daikin Method employing a standard area for outdoor temperature. You can do your calculation on Appendix 1.

(20 marks)

Question 2

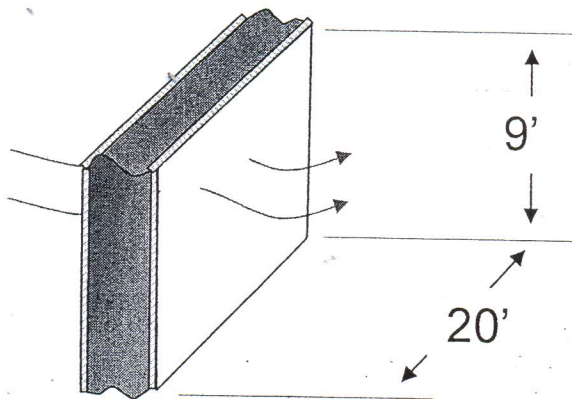
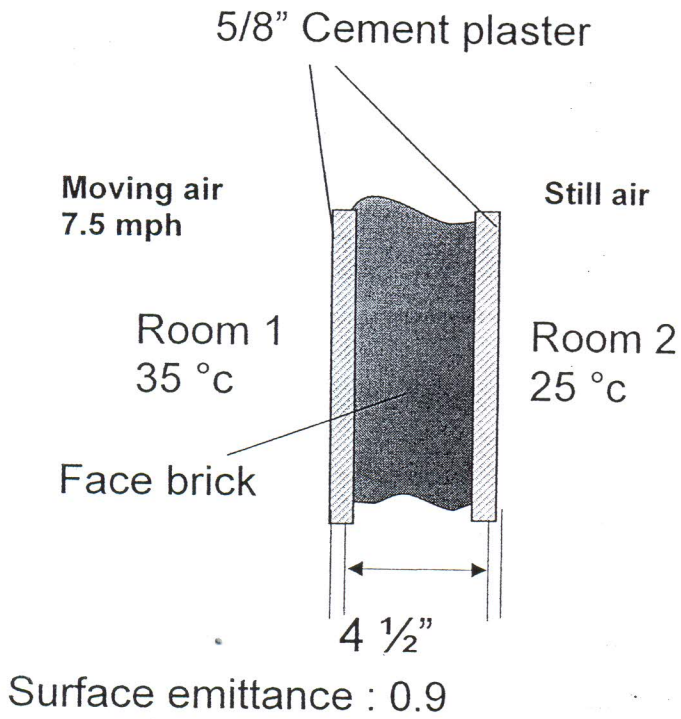


Figure Q2: Heat Transfer

(a) Referring to Figure Q2, calculate:

i. Total Thermal Resistance, ΣR in $\text{Ft}^2 \cdot \text{hr} \cdot \text{F} / \text{Btu}$

(15 marks)

ii. Overall Heat Transfer Coefficient, U in $\text{Btu} / \text{Ft}^2 \cdot \text{hr} \cdot \text{F}$

(5 marks)

Question 3

- (a) Give the full definition for the below terms in Solar Radiation:
- i. Soltices
(4 marks)
 - ii. Equinox
(4 marks)
- (b) Determine the Solar Time corresponding to noon local time on 21st March in Bandar Baru Bangi.
(5 marks)
- (c) Calculate the Solar Time and Hour Angle corresponding to solar noon on 21st April in Bandar Baru Bangi.
(7 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO questions.
Please use the answer booklet provided.

Question 4

- (a) You are required to show in detailed calculation steps involved in the following conversion of units.

(10 marks)

- i. $3 \text{ m}^3/\text{hr}$ converted to cfm
- ii. $2 \text{ m}^3/\text{hr}$ converted to cfm
- iii. 5 l/s converted to cfm
- iv. 4 m/s converted to fpm
- v. 2 l/s converted to m^3/hr

- (b) Explain three (3) modes of heat transfer complete with their examples.

(6 marks)



8 inch

Figure Q3 (c): Concrete Block

- (c) Referring to Figure Q3 (c), calculate the Thermal Resistance, R in $\text{Ft}^2 \cdot \text{hr} \cdot \text{F} / \text{Btu}$ for the concrete block.

(4 marks)

Question 5

Surface emittance $\epsilon = 0.2$

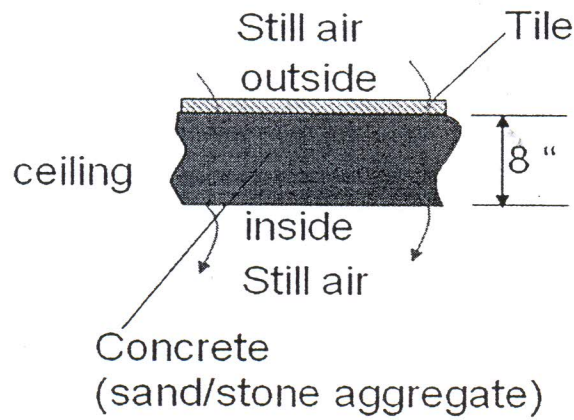


Figure Q4: Floor

Referring to Figure Q5 ceiling, given that the surface emittance is 0.2, you are required to find:

- (a) Thermal Resistance, R for each material in $\text{Ft}^2 \cdot \text{hr} \cdot \text{F} / \text{Btu}$ (10 marks)
- (b) Total Thermal Resistance, $\sum R$ in $\text{Ft}^2 \cdot \text{hr} \cdot \text{F} / \text{Btu}$ (5 marks)
- (c) Overall Heat Transfer Coefficient, U in $\text{Btu} / \text{Ft}^2 \cdot \text{hr} \cdot \text{F}$ (5 marks)

Question 6

Calculate the Direct Normal radiation for roof surface with 45° tilt from vertical on 21st May 2011 facing South 30° East. The building is in Kota Bahru, Kelantan and the solar time is 13:22:30. Also given, the hour angle is 20.55° and its solar altitude is 66.93° .

(20 marks)

END OF QUESTION

Appendix 1

Submit this table together with your answer booklet



Cooling load list

Date : _____

Company : _____
 Address : _____
 Name of room : _____
 Floor : _____

Name of person in charge : _____
 Room area (W) : _____ m²
 Room Volume :(Area) : _____ m³

Items			A	Cooling				
				Coefficient B	C = A x B	Coefficient f	Load Q = f X C	
Wall faced to the outdoor			m ²			1		
			m ²					
			m ²					
			m ²					
			m ²					
Roof			m ²					
Window glass		AREA	m ²			Coefficient of blind		
			m ²					
			m ²					
			m ²					
Partition			m ²			1		
			m ²					
Ceiling			m ²					
Floor			m ²					
Outdoor air	Invasion of outdoor air	Room Vol.	m ³			Area corr.	1	
Heat generation in the room	Person	Number				1		
		Number				1		
	Light	Electric light		kw	860		Rate of using	1
		Fluorescent light		kw	1000			1
	Electric apparatus			kw	860			1
				kw	860			1
SH	equipment		m ³ /h					
	person		m ³ /h					
btu/h = kcal/hr x 3,97				***		Total cooling load(kcal/hr)		
						Residential Coefficient	0,7	
						Total cooling load(btu/hr)		

Formula:

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