

**BITS, Pilani –Dubai**

Dubai International Academic City, Dubai, U.A.E

IV Year I Semester 2010-2011

**COMPREHENSIVE EXAMINATION [CLOSED BOOK]**

**Course No.** ME C461

**Course Title:** REFRIGERATION &A/C

**Max.Marks:** 80

**Weightage:** 40%

**Date:** 29/12/2010

**Duration:** 3HRS

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Notes:

- Answer all the questions
  - Draw neat sketches wherever necessary
  - Make suitable assumptions if required and clearly state them
  - **Refrigeration charts and Tables** are permitted
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1. Enumerate the difference between refrigeration and air conditioning :- **[3M]**
2. What is the standard rating of a refrigeration machine ? **[3M]**
3. Explain the **boot strap air Refrigeration** systems:- **[6M]**
4. Describe a simple **vapour absorption** cycle giving clearly its flow diagram:- **[5M]**
5. What are Azeotropes refrigerants? what are the different methods & equipments to determine refrigerants leakage ?:- **[6M]**
6. What is the difference between wet compression and Dry compression **[3M]**
7. A vapour compression heat pump is driven by power cycle having a thermal efficiency of 25%. For the heat pump, refrigerant R-12 is compressed from saturated vapour at 2 bar to the condenser pressure of 12 bar. The isentropic efficiency of the compressor is 80%. Saturated liquid enters the expansion valve at 12 bar. For the power cycle 80% of the heat rejected by it is transferred to the heated space which has a total heating requirement of 500 kJ/min. Determine the **power** input to the heat pump compressor. **[10M]**
8. Explain **comfort** Air conditioning and **metabolic rate** **[6M]**
9. Moist air at DBT 294K and WBT 280 K is processed to a final WBT of 286 K using saturated steam at 383 K. Obtain the relative humidity, DBT of the final state of air and the steam required per hour. **[8M]**

10. An air duct system is provided as shown in Fig below. Determine the dimensions of AB, BC, CD and the total pressure at fan outlet using **equal friction method**. Choose a friction rate of 0.08 mm water /m length of duct. Assume free exit at each out let.

Losses For elbow :  $0.25 P_{v2}$ ,

For branch :  $0.2 P_{v2} + \text{Elbow loss}$  .

For straight-through section :  $0.25 \times \text{difference of velocity pressures}$ .

[12M]

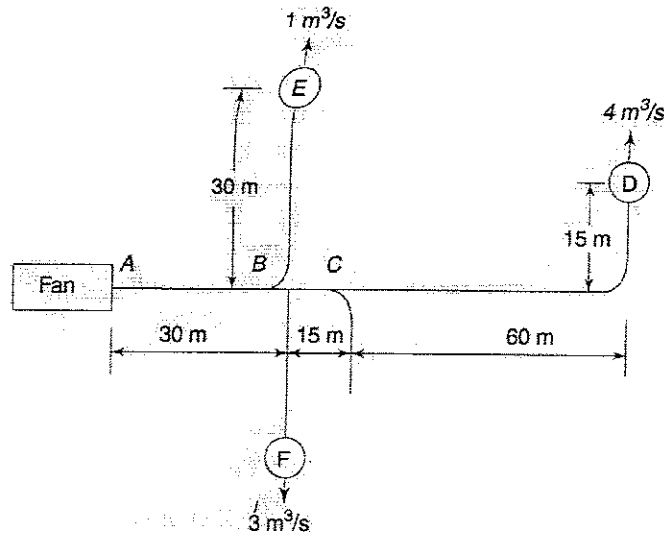


Fig Duct Layout

11. Calculate the total heat gain of a Restaurant at its peak occupancy load at about 5 pm when 100 diners and 15 employees are present. Given:

[18M]

Heat gain through walls and roof : 2500 kJ/h

Heat gain through glass areas : 500 kJ/h

Number of fluorescent tube lights : 60

Rating of each tube light : 40W

Rating of toasters inside space : 2650 W

Sensible heat gain per diner : 250 kJ/ h

Latent heat gain per diner : 260 kJ/ h

Inside design conditions :  $25^{\circ}\text{C}$  DBT ,  $19^{\circ}\text{C}$  WBT

Ventilation requirement : 0.4 cmm/person

**Table 18.13** Infiltration through Doors on Adjacent Walls (Wind Velocity 12 kmph)<sup>3</sup>

Description	cmm/m <sup>2</sup> Area		cmm	
	No Use	Average Use	Standing Open	
			No Vestibule	Vestibule
Revolving Doors				
Normal Operation	0.24	1.58	—	—
Panels Open	—	—	34	25
Glass Door-4.75 mm Crack	1.37	3.0	20	14
Wood Door	0.3	1.98	20	14
Small Factory Door	0.23	1.98	—	—
Garage and Shipping				
Room Door	0.61	1.37	—	—
Ramp Garage Door	0.61	2.06	—	—

**Table 18.12** Infiltration through Doors-Crack Method<sup>3</sup>

Type of door	cmm per Linear Metre of Crack					
	Wind Velocity, kmph					
	8	16	24	32	40	48
Glass door						
Good installation						
3.2 mm crack	0.3	0.6	0.9	1.21	1.49	1.77
Average installation						
4.76 mm crack	0.45	0.93	1.3	1.86	2.23	2.7
Poor installation						
6.4 mm crack	0.6	1.21	1.77	2.42	2.42	3.53
Ordinary wood or metal door						
Well fitted						
W-stripped	0.04	0.06	0.08	0.12	0.16	0.2
Well fitted						
Now W-stripped	0.08	0.11	0.17	0.24	0.31	0.39
Poorly fitted						
Not W-stripped	0.08	0.21	0.34	0.48	0.61	0.78
Factory door						
3.2 mm crack	0.3	0.6	0.9	1.21	1.49	1.77

**Table 18.11** Infiltration through Double-Huge Windows in m<sup>3</sup>/h/m of Crack<sup>3</sup>

Window type	Pressure Difference, cm H <sub>2</sub> O				
	0.25	0.50	0.75	1.00	1.25
Non-weather-stripped, loose fit	7.1	11.3	14	18	21
Non-weather-stripped, average fit	2.5	4	5.3	6.4	7.4
Weather-stripped, loose fit	2.5	4	5.3	6.4	7.4
Weather-stripped, average fit	1.3	2.1	2.8	3.3	3.9

**Table 16.2** Ventilation Air Requirements

Application	Smoking Status	Recommended cmm/person	Minimum	
			cmm/person	cmm/m floor area
Apartments	Some	0.56	0.28	—
Offices and factories	Occasional-Some	0.28-0.6	0.21	—
Restaurants	Some	0.4	—	—
Board rooms	Very heavy	1.4	0.56	0.03
Department stores	None	0.21	0.14	0.0015
Theatres	None	0.21	0.14	—
Hotel rooms	Heavy	0.84	0.7	—
Hospital wards	None	0.84	—	—
Hospital operation theatres	None	All outdoor	—	—

$$\frac{\Delta p_f}{L} = \frac{0.002268 \dot{Q}_v^{1.852}}{D^{4.973}}$$

$$\Delta p = 0.00047 (C)^2$$

$$P_{VA} = \left( \frac{C}{4.04} \right)^2$$

**Table 19.1** Heat Liberated due to Occupancy

Activity	Metabolic Rate W	Heat Liberated, W							
		Room Dry Bulb Temperature, °C							
		20		22		24		26	
		S	L	S	L	S	L	S	L
Seated at rest	115	90	25	80	35	75	40	65	50
Office work	140	100	40	90	50	80	60	70	70
Standing	150	105	45	95	55	82	68	72	78
Eating in restaurant	160	110	50	100	60	85	75	75	85
Light work in factory	235	130	105	115	120	100	135	80	155
Dancing	265	140	125	125	140	105	160	90	175

**BITS, Pilani –Dubai**

Dubai International Academic City, Dubai, U.A.E

IV Year I Semester 2010-2011

**Test No.2 (Open Book)**

**Course No.** ME C461

**Course Title:** REFRIGERATION & A/C

**Date:** 12-12-2010

**Max.Marks:** 20

**Weightage:** 20%

**Duration:** 50 min.

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Notes:

- Answer all the questions.
  - Text Book and Hand written class notes are permitted.
  - Draw neat sketches wherever necessary
  - Make suitable assumptions if required and clearly state them.
  - Psychometric charts are permitted.
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**Q1.** Why is the *psychrometric chart* most commonly employed in solving problems on air conditioning ? **[2M]**

**Q 2.A.** Explain *Vasodilation* & *Vasoconstriction* **[2M]**

**B.** An Office Room of 10 seating capacity is conditioned for the given data as follows:

Outdoor conditions: 38<sup>0</sup>C and 60% R.H.

Required Indoor conditions: 22<sup>0</sup>C and 40% R.H

The quantity of air supplied: 0.42 m<sup>3</sup> / min / person

The required condition is achieved first by cooling and dehumidifying and then heating.

Find the followings:

**(a)** The Capacity of the cooling coil in Tons of refrigeration

**(b)** By-pass factor of the heating coil if the surface temperature of the coil is 22<sup>0</sup>C. **[6M]**

**Q.3.** An Air-Conditioning system is to be designed for a **small Restaurant** when the following data is available:-

Transmission gain through Doors, Glass, Roof & Floor = 15000 kJ/hr

Solar transmission through Walls, Roof & Floor = 16000 kJ/hr

Solar Heat gain through glass = 7000 kJ/hr.

Equipment sensible heat gain = 10500 kJ/hr

Equipment Latent heat gain = 2500 kJ/hr

Infiltrated air flow = 400 m<sup>3</sup>/hr

The Hall seating capacity = 50

Servants serving meals = 5

Sensible heat gain per diner : 250 kJ/ h

Latent heat gain per diner : 260 kJ/ h

Outside Design conditions: 35<sup>0</sup>C DBT and 26<sup>0</sup>C WBT

Inside design conditions : 25<sup>0</sup>C and 55% RH

By pass factor of the coil is 0.18

Find the Room **Sensible Heat Load** in tons in the Restaurant

**[10M]**

**BEST OF LUCK**

**BITS, Pilani –Dubai**

Dubai International Academic City, Dubai, U.A.E

IV Year I Semester 2010-2011

**Test No.1 (Closed Book)**

**Course No.** ME C461

**Course Title:** REFRIGERATION & A/C

**Date:** 31-10-2010

**Max.Marks:** 25

**Weightage:** 25%

**Duration:** 50 min.

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Notes:

- Answer all the questions
  - Draw neat sketches wherever necessary
  - Make suitable assumptions if required and clearly state them
  - Refrigeration charts and Tables are permitted
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**Q1. A.** Explain *Ice Making Test* for Domestic Refrigerator **[3M]**

**B.** A Freon-12 vapor compression system operating at a condenser temperature of  $40^{\circ}\text{C}$  and an evaporator temperature of  $0^{\circ}\text{C}$  develops 15 tons of refrigeration.

Determine:

- The discharge temperature and mass flow rate of the refrigerant circulated.
- The theoretical horse power of the compressor
- The heat rejected in the condenser.
- The Carnot COP and actual COP of the

**[8M]**

**Q2.A.**How *multiple pressure* refrigeration system improve the coefficient of performance **[2M]**

**B.** Explain *Cascading* in Refrigeration **[3M]**

**Q3.A.** Write the chemical formula of *F-113* with steps **[3M]**

**B.** Explain **GWP & ODP** with examples:- **[3M]**

**C** Explain **Thermostatic** Expansion Valve:- **[3M]**

**BEST OF LUCK**

**BITS, PILANI – DUBAI**  
**FIRST SEMETER SEMESTER 2010 – 2011**  
**QUIZ-2**

Course Code: ME C461 / CHE C471

FINAL YEAR

Date: 25-11-2010

Course Title: **REFRIGERATION & A/C**

Max Marks: 14

Duration: 20 minutes

Weightage: 7%

**Name:** ..... **ID No:** ..... **Prog:** .....

1. 30 CMM of a stream of moist air at 15<sup>0</sup>C DBT and 13<sup>0</sup>C WBT are mixed with 12 CMM of a second stream at 25<sup>0</sup>C DBT and 18<sup>0</sup>C WBT. Barometric pressure is one STD atmosphere. Calculate

a) Dry Bulb temperature of the resulting mixture (2 Marks )

b) Wet Bulb temperature of the resulting mixture (2 Marks )

2. Explain *SHF*. When SHF will have the values zero & 1 (2 Marks)

3. Explain By pass factor & Contact Factor

(4 Marks)

4. In an Absorption type refrigeration system, heating, cooling and refrigeration take place at the temperature of  $100^{\circ}\text{C}$ ,  $20^{\circ}\text{C}$ , and  $-10^{\circ}\text{C}$ . Find the theoretical COP of the system. (3 Marks)

5. When water is used as Refrigerant in Vapour Absorption system, what is the corresponding Absorber used:- (1 Marks)



**BITS, PILANI – DUBAI**  
**FIRST SEMESTER 2010 – 2011**  
**FINAL YEAR**

**Course Code:** ME C461 / CHE C471  
**Course Title:** REFRIGERATION & A/C  
**Duration:** 20 minutes

*quiz - 1*

**Date:** 04-10.10  
**Max Marks:** 16  
**Weightage:** 8%

<b>Name:</b> .....	<b>ID No:</b> .....	<b>Sec / Prog:</b> .....
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Instructions: 1. Attempt all questions
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1. Explain **DART** (2 Marks)

2. Represent **BOOT STRAP** Air refrigeration system on T-s diagram (3Marks)

3. Explain the importance of **Expansion valve** in Refrigeration system

(3 Marks)

4. Explain Internal heat sources

(3Marks)

5 Explain the difference between **Refrigeration & Air conditioning**

(3 Marks)