BITS, Pilani –Dubai Campus

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

IV Year II Semester 2010-2011

COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Course No. CHE C471 / ME C461 **Course Title:** REFRIGERATION &A/C

Max.Marks: 80 **Weightage:** 40%

Date: 05-06-2011 **Duration:** 3HRS

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

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** system:- **[6M]**
4. Explain the different methods of improving the **COP** of a simple vapor compression refrigeration cycle :- **[5M]**
5. Explain **Flash chamber** in a **Multi compression** refrigeration systems with help of P-H diagram **[6M]**
6. The evaporator and the condenser temperatures of 20 tonnes capacity freezer are -28^{0}C and 23^{0}C respectively. The refrigerant R-22 is sub cooled by 3^{0}C before it enters the expansion valve and is superheated to 8^{0}C before leaving the evaporator. The compression is isentropic. A six cylinder single acting compressor with stroke equal to bore running at 250 rpm is used.

   Determine:

   (i) Refrigerating effect/ kg.

   (ii) Mass of refrigerant to be circulated per minute.

   (iii) Theoretical piston displacement per minute.

   (iv) Theoretical power.

   (v) COP

   (vi) Theoretical bore & stroke of the compressor.

   Neglect valve throttling and clearance effect. **[10M]**

7. Explain the desirable properties of ideal refrigerants: **[3M]**
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 Pv_2,

For branch : 0.2 Pv_2 + Elbow loss .

For straight-through section : 0.25 x difference of velocity pressures. **[12M]**

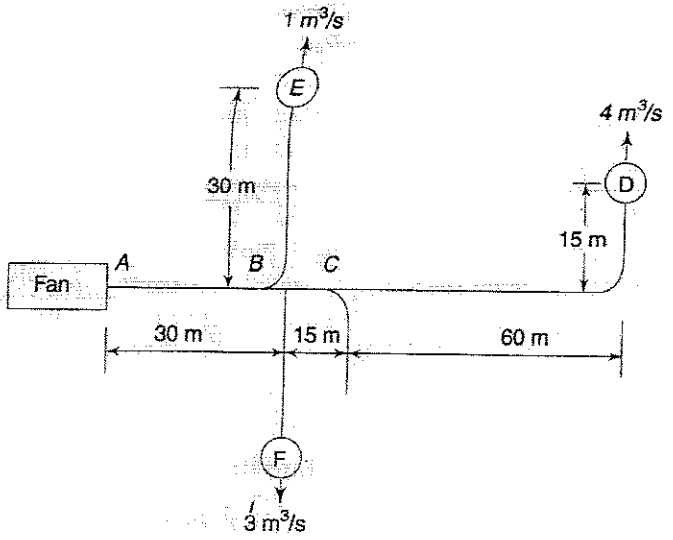

Fig Duct Layout

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 : 2400 kJ/h
Heat gain through glass areas : 520 kJ/h
Number of fluorescent tube lights : 50
Rating of each tube light : 60W
Rating of toasters inside space : 5W
Sensible heat gain per diner : 240 kJ/ h
Latent heat gain per diner : 250 kJ/ h
Sensible heat gain per employee : 300 kJ/ h
Latent heat gain per employee : 550 kJ/ h
Inside design conditions : 24^{0}C DBT , 20^{0}C WBT
Ventilation requirement : 0.5 cmm/person

Table 18.13 Infiltration through Doors on Adjacent Walls (Wind Velocity 12 kmph)[3]

Description	*cmm/m² Area*		*cmm*	
			Standing Open	
	No Use	*Average Use*	*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[3]

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 $m^3/h/m$ of Crack[3]

Window type	*Pressure Difference, cm* H_2O				
	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*	*Minimum 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	—	—

$$\frac{\Delta p_f}{L} = \frac{0.002268\,\dot{Q}_v^{1.852}}{D^{4.973}} \qquad \Delta p = 0.00047\,(C)^2 \qquad p_{V_A} = \left(\frac{C}{4.04}\right)^2$$

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 Campus

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

IV Year II Semester 2010-2011

Test No.2 (OPEN BOOK)

Course No. CHE C471 /ME C461 **Course Title:** REFRIGERATION &A/C

Max.Marks: 20 **Weightage:** 20%

Date: 17- 04- 2011 **Duration:** 50 min.

Notes:

- Answer all the questions
- Draw neat sketches wherever necessary
- Make suitable assumptions if required and clearly state them
- ***Refrigeration charts and Tables*** **& Psychometric charts** are permitted

1. In an ***Aqua-ammonia*** Absorption Refrigeration system, heating, cooling and refrigeration take place at the temperatures of 120^0C, 30^0C and -10^0C .Find the following:
   a. Ideal COP of the system
   b.If the heating temperature is increased to 160^0C and refrigeration temperature is decreased to -20^0C , find the percentage change in ideal COP **[5M]**
2. What is the condition for DBT = WBT = DPT ? **[2M]**
3. What is the role of relative Humidity and specific humidity in Air conditioning equipment? **[2M]**
4. Have a ***absorption refrigerators*** ever been made using ***sulphurdioxide*** ? What is the absorber used here? **[2M]**
5. Is it proper to compare COP's of the vapour-***absorption*** and vapour–***compression*** systems obtained on the basis of different forms of energy? **[2M]**
6. Why is the ***psychrometric chart*** most commonly employed in solving problems on air conditioning ? **[2M]**
7. What modifications are necessary in a simple Absorption Refrigeration system in order to improve the performance of the systems:- **[3M]**
8. "For a given state of refrigerant, the pressure drop is inversely proportional to the length and directly proportional to the bore diameter of the Capillary tube." Is this statement is correct or not? Justify your answer. **[2M]**

BITS Pilani, Dubai Campus

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

IV Year II Semester 2010-2011

Test No.1 (Closed Book)

Course No. CHE C471 /ME C461 **Course Title:** REFRIGERATION &A/C

Date: 27-02-2011 **Max.Marks:** 25 **Weightage:** 25%

Duration: 50 min.

Notes:

- Answer all the questions
- Draw neat sketches wherever necessary
- Make suitable assumptions if required and clearly state them
- Refrigeration chats and Tables are permitted

Q 1 A. Enumerate the difference between ***Refrigeration*** and ***heat pump*** **[3M]**

B. Explain ***COP*** **[2M]**

Q 2.A. Describe Aircraft Refrigeration systems **[3M]**

B. A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 35^0C and the lower temperature is -15^0C. The capacity is to be 12 tonnes. Neglect all losses. Determine: (i) COP (ii) Heat rejected from the System /hr.(iii) Power required **[6M]**

Q.3.A. Describe Bell Coleman cycle **[3M]**

B. An air-cooling system for a jet plane cockpit operates on simple cycle. The cockpit is to be maintained at 25^0C. The ambient air pressure and temperature are 0.35 bar and -15^0C respectively. The pressure ratio of the jet compressor is 3. The plane speed is 1000 kilometers per hour. The pressure drop through the cooler coil is 0.1bar. The pressure of air leaving the cooling turbine is 1.06bar and that in the cockpit is 1.01325bar. The cockpit cooling load is 58.05kW. Calculate:

(1) Stagnation temperature and pressure of the air entering the compressor.

(2) COP of the system **[8M]**

BEST OF LUCK

BITS PILANI, DUBAI CAMPUS

SECOND SEMESTER 2010 – 2011

QUIZ-II

Course Code: ME C461 / CHE C471 **FINAL YEAR** Date: 2-05- 2011

Course Title: REFRIGERATION & A/C Max Marks: 14

Duration: 20 minutes Weightage: 7%

Name: ..... **ID No:** ..... **Sec / Prog:** .....

Instructions: 1. Attempt all questions

1. Draw the neat sketch of summer Air Conditioning (3 Marks)

2. 30 CMM of a stream of moist air at 15^0C DBT and 13^0C WBT are mixed with 12 CMM of a second stream at 25^0C DBT and 18^0C WBT. Barometric pressure is one STD atmosphere. Calculate Dry bulb & Wet Bulb temperature of the resulting mixture (3 Marks)

3. Explain SHF :- what is the value of SHF for common in Air conditioning practice – at normal dry climate. (2 Marks)

4. Write any three factors required for comfort Air conditioning:- (2 Marks)

5. What is Vasodilatation & Vasoconstriction :- (2 Marks)

6. What are the three categories of Industrial A/C (2 Marks)

BITS PILANI, DUBAI CAMPUS

SECOND SEMESTER 2010 – 2011

QUIZ-I

Course Code: ME C461 / CHE C471 **FINAL YEAR** Date: 21-03- 2011

Course Title: REFRIGERATION & A/C Max Marks: 16

Duration: 20 minutes Weightage: 8%

Name: ..... **ID No:** ..... **Sec / Prog:** .....

Instructions: 1. Attempt all questions

1. Explain the CASCADING (3 Marks)

2. Explain the effect of **Suction & Delivery pressure** in a vapour compression refrigeration system (3 Marks)

3. What are the **merits & demerits** of Vapour compression Refrigeration system (2 Marks)

4. Explain Pull-Down characteristics :- (2 Marks)

5. Is COP increased by using flash chamber in vapour compression Refrigeration systems? Justify your answer (3Marks)

6. Represent vapour compression refrigeration having **superheated vapor** & **liquid sub cooling** on a P-H diagram (3Marks)