BITS Pilani, Dubai Campus

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

IV Year I Semester 2012-2013

COMPREHENSIVE EXAMINATION [CLOSED BOOK]

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

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

Date: 03-1-2013 **Duration:** 3HRS

Notes:

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

1a) Analyze the actual ***Bell-Coleman Air refrigeration*** cycle **[5M]**

b) A dense air refrigeration machine operates on reversed Brayton cycle and is required for 10 tonnes of refrigeration capacity. The cooler pressure is 4.2 bar and refrigerator pressure is 1.4 bar. The air is cooled in the cooler to a temperature of 50^0Cand the temperature of air at inlet to the compressor is -20^0C. For an ideal cycle, determine the following:

(i) COP of the system

(ii) Mass of air circulated per minute

(iii) Theoretical piston displacement of the compressor

(iv) Net power per ton of refrigeration, Show the cycle on p-v and T-s diagrams. **[10M]**

2a) Enumerate the ***Merits & Demerits*** of Vapour compression refrigeration system over air refrigeration system **[5M]**

b) An ammonia refrigerator produces 20 tons of ice per day from and at 0^0C. The condensation and evaporation takes at 20^0C and -20^0C respectively. The temperature of vapour at the end of isentropic compression is 50^0C and there is no under-cooling of the liquid. The actual C.O.P is 70 % of the theoretical C.O.P. Determine:

i. The **rate** of ammonia circulation

ii. The **size** of the single acting compressor when running at 240 rpm assuming L= D and volumetric efficiency of 80% Take latent fusion of ice = 335kJ/kg. **[9M]**

3a) Explain the principle of Vapour Absorption refrigeration system **[5M]**

b) What is the importance of Hydrogen in Electrolux Refrigerator **[3M]**

c) Explain Alternative Refrigerants **[4M]**

4a) Explain with diagram the ***Summer Air conditioning*** **[5M]**

b) Explain ***Vasodilation*** & ***Vasoconstriction*** **[4M]**

5. 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^3/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 : 35^0C DBT and 26^0C WBT

Inside design conditions : 25^0C and 55% RH

By pass factor of the coil is 0.15

Find the **Room Sensible & Latent heat load** and **total load** in the Restaurant **[18M]**

6. Find the Duct sizes by ***Equal friction Methods*** for the duct layout shown below.

Assume velocity in main duct A is 300 mpm. Also assume dynamic loss coefficient in elbow K = 0.22 and static regain factor in fitting R = 0.75. Static pressure at each out let is 4mm of water. **[12M]**

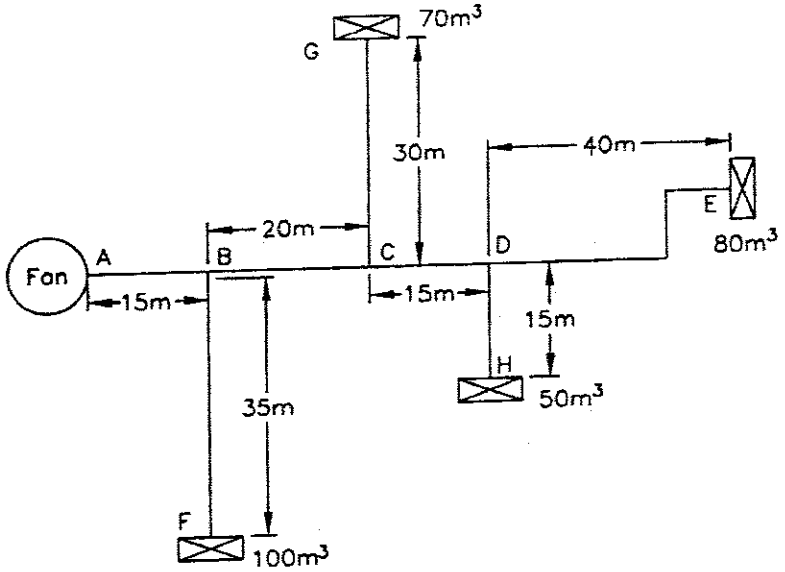

TABLE 16.2 VENTILATION AIR REQUIREMENT

Application	Smoking Status	Recommended cmm/Person	Minimum	
			cmm/ person	cmm/m floor area
Apartments	Some	0.56	0.28	—
Offices and factories	Occasional-Som	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	—	—

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

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

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IV Year I Semester 2012-2013

Test No.2 (Open Book)

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

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

Date: 09-12-2012 **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*** are permitted

Q.1. 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]**

Q.2. An Auditorium of 1000 seating capacity is conditioned for the given data as follows:

Outdoor conditions: 35^0C and 60% R.H.

Required Indoor conditions: 15^0C and 40% R.H

The quantity of air supplied: 0.5 m^3 / 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) Capacity of heating coil in kW

(c) By-pass factor of the heating coil if the surface temperature of the coil is 22^0C.

[7M]

Q.3. Why is the ***psychrometric chart*** most commonly employed in solving problems on air conditioning? **[2M]**

Q.4. What modification is necessary in a simple Absorption refrigeration system in order to improve the performance of the system **[2M]**

Q5. In an ***Aqua-ammonia*** Absorption Refrigeration system, heat is supplied to the generator by condensing steam at 0.3 MPa, 75% quality. The temperature to be maintained in the Refrigerator is -12^0C, and the ambient temperature is 32^0C. Estimate the ***maximum COP*** of the refrigerator.If the actual COP is 42 % of the maximum COP and the refrigeration load is 21 tones, what will the required ***steam flow rate*** be? **[7M]**

BEST OF LUCK

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IV Year I Semester 2012-2013

Test No.1 (Closed Book)

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

Max.Marks: 25 **Weightage:** 25%

Date: 18-10-2012 **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*** are permitted

Q 1 A. Explain the difference between Refrigerator & Heat pump **[3M]**

B Explain pull down characteristics in vapour compression Refrigeration systems **[3M]**

C. Represent all thermal properties for a refrigerant in **P-h diagram** **[3M]**

Q 2. In a Bell-Coleman refrigeration plant, air is drawn into the cylinder of the compressor at atmospheric pressure of 1 bar and temperature – 5^0C; and it is compressed isentropic ally to 5 bar and it is cooled to 15^0C at the same pressure. It is then expanded in an expansion cylinder to atmospheric pressure and discharge to the refrigerating chamber. If the law for expansion is $Pv^{1.2}$ = constant, find the work done on air per kg. and COP of the refrigerating plant. Take γ = 1.4 and C_p = 1 kJ/kg.^{0}C for air . **[8M]**

Q.3. A ammonia refrigeration system operates between saturated suction temperature of -20^0C and saturated discharge temperature of +40^0C. Compare the COP of the cycle using wet compression with that of the cycle using dry compression

Assume that the vapour leaving the compressor is saturated in the case of wet compression and the vapor entering the compressor is saturated in the case of dry compression. The refrigerant leaves the condenser as saturated liquid. **[8M]**

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FIRST SEMESTER 2012 – 2013

QUIZ- II

Course Code: ME C461 / CHE C471 **FINAL YEAR** Date: 11-12- 2012

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

Duration: 20 minutes Weightage: 7%

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

Instructions: 1. Attempt all questions

1. Explain ***Apparatus Dew point*** temperature: - **2 marks**

2. What is the role of ***third fluid*** & ***Analyze***r in the vapour absorption refrigeration system :-

3 marks

3. What is the significance of a lower value of SHF. Explain **3 marks**

4 100 cu.m of air per minute at 30^0C DBT and 60% R.H is cooled to 20^0C DBT by passing through a cooling coil. Find the capacity of cooling coil in tons of refrigeration **3 marks**

5. What is the difference Summer & Winter Air conditioning:- **3 marks**

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FIRST SEMESTER 2012 – 2013

QUIZ-I

Course Code: ME C461 / CHE C471 **FINAL YEAR** Date:17-10- 20112

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 Bell-Coleman refrigeration system with ***T-s and Pv*** diagram 3 marks

2. Explain Boot strap air refrigeration system 4 marks

3. Compare Actual Bell Coleman cycle with theoretical one :- 3 marks

4 Explain ***DART*** 3 marks

5. Expalin different causes for external heat sources:- 3 marks