



RM-7165

B. E. III (Sem. VI) (Mech.) Examination

May / June – 2010

Refrigeration & Air Conditioning

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

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|--|----------------------|
| નીચે દર્શાવેલ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.<br>Fillup strictly the details of signs on your answer book.                            | Seat No. :           |
| Name of the Examination :  | <input type="text"/> |
| <input type="text" value="B. E. 3 (Sem. 6) (Mech.)"/>  | <input type="text"/> |
| Name of the Subject :  | <input type="text"/> |
| <input type="text" value="Refrigeration &amp; Air Conditioning"/>  | <input type="text"/> |
| Subject Code No. : <input type="text" value="7"/> <input type="text" value="1"/> <input type="text" value="6"/> <input type="text" value="5"/> | <input type="text"/> |
| Section No. (1, 2,.....) : <input type="text" value="1&amp;2"/>  | <input type="text"/> |
|  | Student's Signature  |

- (2) Answer **all** questions.
- (3) Use **separate** answer book for each section
- (4) Figure to the **right** indicate full marks.
- (5) Assume suitable data, if **necessary**.
- (6) Use of steam table, molier diagram, refrigeration charts are permitted.

### SECTION - I

- 1 (a) Answer any **five** : 10
  - (i) Derive the nomenclatures of following refrigerants  
Dichloro Tetraflouro Ethane  
Dichloro Diflouro Methane
  - (ii) Justify the statement, "In multi-evaporator system, multiple expansion valve arrangement is better than individual expansion valve arrangement"
  - (iii) If power consumption of Domestic Air Conditioner increases, what can be suspected reasons?
  - (iv) "Power consumption of VCR system decreases in winter compared to summer". True or False. Justify your answer with suitable comment.
  - (v) List the methods of leakage detection for refrigerants?
  - (vi) How thermostat works in Domestic Refrigerator?
  - (vii) It is observed that water drips from backside of window air conditioner unit. Why?
- 2 Answer any **two**. 10
  - (i) Why air cycle refrigeration is used for aircraft applications? Describe regenerative type of air cycle refrigeration.

- (ii) Explain with sketch various components and their functions of vapour absorption system. Under what situation, the vapour absorption system of refrigeration is preferred over vapour compression system.
- (iii) Explain the effect of change in evaporator pressure in vapour compression system.

**3** Attempt any **three** :

**30**

- (i) A R-12 plant has to produce 15 ton of refrigeration. The condenser and evaporator temperature are 40°C and - 5°C respectively. Determine :
  - (a) Refrigerant mass flow rate
  - (b) Theoretical piston displacement
  - (c) Operating Pressure Ratio
  - (d) Power required to drive the compressor.
  - (e) Flash gas percentage after throttling
  - (f) Heat rejected in condenser
  - (g) COP carnot
  - (h) COP actual.
- (ii) The multi evaporator system works at different temperatures with common compressor, individual expansion valves and back pressure valves. The system is working with R-12 as refrigerant. Three evaporators are operating at 10°C, 5°C and -10° C having 10 TR, 20 TR and 30 TR capacities respectively. A condenser pressure is 9.61 bar. Liquid refrigerant leaving the condenser is sub cooled by 10° C. Vapour leaving the evaporators is in dry and saturated state. Assuming isentropic compression, Determine.
  - (a) Mass flow rate of refrigerant in each evaporator.
  - (b) Compressor Power
  - (c) COP of the system.
- (iii) A bootstrap cooling system of 18 TR refrigeration capacity is employed in a aeroplane. The ambient air temperature and pressure are - 50° C and 0.225 bar respectively. The pressure ratio of the main compressor is 3.5 and required air for refrigeration is bled off from the main compressor. The air taken from the main compressor is further compressed in secondary compressor which is run by cooling air turbine. The output of the cooling air turbine is just sufficient to run the secondary turbine. The refrigerating air coming out from secondary compressor is cooled by ram air to 50° C. The air pressure coming out of the cooling turbine and supplied to the cabin is 1 bar. The temperature maintained in the cabin is 25° C.

Ramming and compressor (primary and secondary) efficiency is 90% and turbine efficiency is 80%. Effectiveness of both the heat exchanger is 0.4,

When the aircraft is moving at 1000 km/h, Calculate

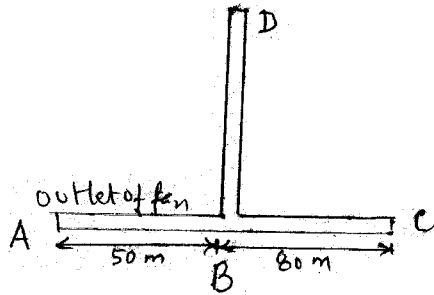
- (a) Delivery pressure of secondary compressor.
  - (b) Mass flow rate supplied to the cabin
  - (c) COP of the system.
- (iv) A two staged vapour compression refrigeration system with a flash chamber operates with ammonia as the refrigerant. The evaporator and condenser temperatures are  $-30^{\circ}\text{C}$  and  $40^{\circ}\text{C}$  respectively. If the capacity of plant is 25 TR, Calculate.
- (a) Work of compression
  - (b) COP of the system
  - (c) COP of the system if compression takes place in single stage.

## SECTION - II

- 4 Attempt the following : 20
- (i) Draw a neat diagram of air conditioning system required in Winter season. Explain the working of different components in the circuit. Is it possible to use the steam for such air conditioning system?
  - (ii)  $100\text{ m}^3$  of air per minute at  $40^{\circ}\text{C}$  DBT and 15% RH is passed through adiabatic humidifier. The air is coming out at  $25^{\circ}\text{C}$  DBT and  $20^{\circ}\text{C}$  WBT. Calculate :  
(a) DPT (b) Water carried by air per minute. Assume  $p = 1.01325\text{ bar}$  (without using psychrometric chart)
  - (iii) Define the terms :  
Relative humidity, Dalton's law of partial pressure, Sensible heat, Moist air Water vapour.
  - (iv) Explain the procedure for incorporating below mentioned loads in Airconditioning load calculations :  
(a) Equipment load (b) Infiltration load
  - (v) With neat sketch explain following Duct arrangement system :  
(a) Perimeter system (b) Extended Plenum system.
- 5 Attempt any one 10
- (i) A duct  $1.5\text{ m} \times 1\text{ m}$  in size carrying conditioned air runs 50 m from the fan outlet then it divides into two parts each of 80 m in length and  $1.5\text{ m} \times 1\text{ m}$  in cross section as shown in figure 1. If the air discharge at point C is  $1600\text{ m}^3/\text{min}$ , determine the quality of air discharged at point D and static pressure at outlet of fan. Calculate duct friction loss using following formula :

$$H_f = \frac{4 f L}{De} \left( \frac{V}{242.1} \right)^2$$

Where  $D_e$  is equivalent diameter of duct  $f=0.005$



- (ii) The following data relates to a restaurant located in Mumbai. Ductside condition  $34^\circ\text{C}$  DBT,  $28^\circ\text{C}$  WBT, Inside design condition  $24^\circ\text{C}$  DBT, 50% RH Solar heat gain through wall, roof and floor 16160 kJ/hr

Solar heat gain through glan 15200 kJ/hr. Number of occupants 13 smoking and 12 non-smoking  
SHG per person 300 kJ /hr  
LHGper person 360 kJ/hr

Internal lighting 15 lamps of 100 W and 100 flurosent tubes of 80 W each. Sensible heat gain from other sources 40,000 kJ/hr

If 40% fresh air and 60% recirculated air are mixed and passed through conditioner coil. Calculate.

- Amount of total heat in  $\text{m}^3$  /hr
- Dewpoint temperature of coil
- Condition of Supply air to room
- Capacity of conditioner in 'Tons'

6 Attempt any two : 20

- Define the term effective temperature and explain its significance in design of airconditioning system.
  - Write brief note on comfort chart.
- The following data refer to air conditioning of a public hall :  
Out door condition =  $40^\circ\text{C}$  DBT ,  $20^\circ\text{C}$  WBT Required comfort condition =  $20^\circ\text{C}$  DBT, 50% RH seating condition = 1000.  
Amount of out door air supplied =  $0.3\text{ m}^3/\text{min}/\text{person}$ .  
If the required condition is achieved first by adiabatic humidifying and then cooling, Calculate :
  - Capacity of Cooling coil and surface temperature of coil if  $\text{BF} = 0.25$
  - Capacity of humidifier and its efficiency.
- The RSH load and RLH Load of an air conditioned space are 25 kw and 5 kw respectively. The room condition is  $25^\circ\text{C}$  DBT and 50% RH. The out door condition is  $40^\circ\text{C}$  dry bulb temperature and 50% RH. The ventilation requirements as such that on mass flow rate basis 20% of fresh air is introduced and 80% of supply air is recirculated. If  $\text{BF} = 0.15$  Determine the following :
  - Supply air flow rate
  - Outside air sensible heat
  - Outside air latent heat
  - Grand total heat
  - Effective room sensible heat factor.