Total No. of Questions : 10] **SEAT No. :**

P3043 **[Total No. of Pages : 5**

[5354]-531
B.E. (Mechanical) (Semester - I)
REFRIGERATION AND AIR CONDITIONING
(2012 Pattern)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:-

1) ***Neat diagram must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***Assume suitable data if necessary and mention it clearly.***
4) ***Use of steam table is allowed.***

Q1) a) Write thermodynamic and chemical properties of refrigerant (min. two of each) **[4]**

b) An air refrigeration used for food storage provides 25 TR. The temperature of air entering the compressor is 7°C and the temperature at exit of cooler is 27°C. The quantity of air circulated in the system is 50kg/min. The compression and expansion both follows the law $pv^{1.3}$ = constant and take $\gamma = 1.4$ and $C_p = 1$kJ/kg K for air. Find **[6]**

i) C.O.P. of the cycle and

ii) power per tonne of refrigeration required by compressor.

OR

Q2) a) Derive an expression for COP of Bell-Coleman cycle. **[6]**

b) The temperature limits of ammonia refrigeration system are 25°C and –10°C. If the gas is dry at the end of compression, calculate C.O.P. of cycle assuming no undercooling of liquid ammonia use table for the properties of ammonia: **[4]**

Temperature (°C)	Liquid enthalpy (kJ/kg)	Latent enthalpy (kJ/kg)	Liquid entropy (kJ/kg K)
25	298.9	1166.94	1.1242
–10	135.37	1297.68	0.5443

P.T.O.

Q3) a) Why flash gas removal is always desirable? Explain in detailed using Schematic diagram. **[6]**

b) A vapour absorber cycle has generator temperature 120 °C evaporator temperature of –10 °C and the ambient temperature of 30 °C. Estimate the maximum possible C.O.P. The actual C.O.P. is 0.5 of maximum C.O.P. If the capacity of the plant is 100TR calculate the heat supplied in kJ per second. **[4]**

OR

Q4) a) Draw a neat diagram of Electrolux refrigeration system and explain its working. **[6]**

b) Why air conditioning is needed in Hospital. **[4]**

Q5) a) An atmospheric air at 30°C dry bulb temperature and 75% relative humidity enters a cooling coil at the rate of 200 m^3/min. The coil dew point temperature is 14°C and the bypass factor of coil is 0.1. Determine: **[6]**

i) The temperature of air leaving the cooling coil

ii) The capacity of the cooling coil in tonnes of refrigeration

iii) Amount of water vapour removed per minute and

iv) Sensible heat factor of the process.

b) The humidity ratio of atmospheric air 28 °C DBT and 760 mm of mercury is 0.016 kg/kg of dry air. **[10]**

Determine:

i) Partial pressure of water vapour

ii) Relative humidity

iii) Dew point temperature

iv) Specific enthalpy and

v) Vapour density

OR

Q6) a) Define and explain the following **[8]**

i) Dew point Temperature

ii) Specific humidity

iii) Pressure of water vapour

iv) Wet bulb temperature

b) An air handling unit in an air conditioner plant supplies total load of 4500m^3/min of dry air which comprises by mass 20% of fresh air at 40°C DBT and 27°C WBT and 80% of recirculated air at 25°C DBT and 50% RH. The air leaves the cooling coil at 13°C saturated state. Calculate the cooling load and room heat gain. Also show the various process involved on skeleton psychrometric chart. The following data can be used. Specific volume of air entering the cooling coil is 0.869 m^3/kg of dry air. **[8]**

Condition	**DBT** °C	**WBT** °C	**RH** %	**Sp. Humidity** (g of water vapour /kg of dry air)	**Enthalpy** kJ/kg of dry air
Outside	40	27	----	17.2	85
Inside	25	----	50	10	51
ADP	13	----	100	9.4	36.8

Q7) a) Explain scroll compressor and state its advantages over reciprocating compressor. **[8]**

b) Explain constructional diagram of Thermostatic Expansion valve and explain its working. State the limitations of TXV. **[8]**

OR

Q8) a) With the neat sketch explain the working of DX and flooded evaporators. **[8]**

b) Explain VAV air conditioning system. What are the advantages over constant volume system? **[8]**

Q9) a) Explain pressure losses in ducts and derive expression for pressure loss due to friction. **[6]**

b) A length of main circular duct has three branch ducts taking equal air volume at equal intervals. Each interval duct has a friction loss of 1.2 mm of water and the static pressure of 4 mm of water is necessary at each branch to cope with its friction loss. If the initial velocity in the main duct of 1.3 m diameter is 9 m/s, calculate velocities and diameter of second and third lengths, whereby static pressure regain is sufficient to overcome the friction loss in succeeding length of main duct up to next branch. The static pressure regain factor is 0.58. Draw the simple sketch of the duct system. **[12]**

OR

Q10) a) What is the meaning of static regain and derive an expression for pressure loss due to sudden enlargement. **[6]**

b) An air conditioning duct runs straight from the fan over 60 m length. It has four equally spaced outlet diffusers mounted on the duct, the last one being at the end of the duct. The volume flow rate through each diffuser is 1 m^3/s. The velocity at the duct inlet is 15 m/s. Carryout the duct design by static regain method if static regain factor is 0.75 at each transition and frictional pressure drop is given by and **[12]**

$$\frac{\Delta P_f}{L} = \frac{0.002268 Q^{1.852}}{D^{4.973}}$$

$$\Delta P_v = \left(\frac{C}{4.04}\right)^2$$