Wednesday,December 11,2019	10:30 am - 01:30 pm	1T01418 - B.E.(MECHANICAL)(SEM VIII) (CBSGS) / 53303 - Refrigeration & Air Conditioning	77689

(3 Hours) **[Total Mark: 80]**

N.B. (1) **Question No. 1** is **compulsory**.
(2) Attempt any **Three** Question from **Q. No. 2** to **Q. No.6**.
(3) Make suitable **assumption** if **required**.
(4) **Illustrate answers** with **sketches** wherever **required**.
(5) Use of **psychrometric, refrigerant charts and tables, friction chart, steam tables** are **permitted**.

1. Solve any **four** questions from following **(Five marks each)** **20**
   a) What is adiabatic saturation process? Explain.
   b) Write note on designation of refrigerant.
   c) Explain with neat sketch the function of thermostatic expansion valve.
   d) Explain the factors affecting human comfort.
   e) What are the applications of refrigeration in food processing and in industrial sector.

2. (a) A bootstrap cooling system used in an aircraft air conditioning system. Temperature and pressure of the atmosphere is 15°C and 0.85 bar. Due to the isentropic ramming action pressure increases to 1 bar. This ram air is used in the heat exchanger. The ram air is then further compressed to 3.25 bar in primary compressor. Pressure after secondary compressor is 4.25 bar. The cabin pressure is maintained at 0.9 bar. Temperature of air leaving the cabin is 22 °C. Compressor efficiency is 90% and turbine efficiency is 85%. Effectiveness of both heat exchangers is 0.7. **12**
   Find (i) COP (ii) power required per ton of refrigeration.
   (b) Explain the detail working of commercial ice plant. **8**

3. (a) A R- 12 vapour compression system includes a liquid to vapour heat exchanger in the system. A freezer of capacity 25 TR operates between -30 °C and 25 °C respectively. Refrigerant is sub cooled by 4 °C and superheated by 5 °C before entering the compressor. If a six cylinder, single acting compressor with bore equal to stroke and operating speed of 900 rpm is used, determine **12**
   (i) Ideal COP
   (ii) COP of the system
   (iii) Mass for refrigerant per unit time
   (iv) Theoretical piston displacement per minute
   (v) Bore and stroke of compressor
   (vi) Assume volumetric efficiency of compressor as 85%

(b) A rectangular duct suction 500 mm x 350 mm size carries 1.25 m^3/s of air having density of 1.15 kg/m^3. Determine equivalent diameter of circular duct if **08**

a) The quantity of air carried in both cases is same.

b) Velocity of air in both the cases is same. If f = 0.001 for sheet metal, find pressure loss per 100 m length of duct.

4. (a) The following data are given for the space to be air conditioned: outside air conditions =45 °C DBT and 50% RH, inside design conditions = 28°C DBT and 50% RH, apparatus dew point temperature = 10°C; bypass factor of the cooling coil = 0.2. The return air from the room is mixed with the outside air before entry to the cooling coil in the ratio of 3:1 by mass. If 22 m^3/min of fresh air is supplied, **12**

Find: (1) condition of air leaving the coil
(2) capacity of cooling coil in TR,
(3) Room sensible heat factor

(b) Describe vapour absorption refrigeration system using three fluids. **08**

5. (a) The room sensible and latent heat loads, for an air conditioned space are 25 kW and 7.5 kW respectively. The room condition is 26 °C dry bulb temperatures and 50% relative humidity. The ventilation requirement is such that on mass flow rate basis 25% of fresh air introduced and 75% of supply air is re-circulated. The bypass factor of the cooling coil is 0.15. Determine **12**

i) Supply air flow rate
ii) Outside air sensible heat
iii) Outside air latent heat
iv) Grand total heat

(b) Discuss desirable thermodynamic properties of refrigerants. Explain numbering systems of refrigerant with an example. **04**

(c) Write note on promising alternatives to CFC's Refrigerants. **04**

6. Write note on the following **(any FOUR)** : **20**

i) Energy efficiency ratio and BEE star rating.
ii) Electrolux refrigeration system
iii) Thermo acoustic refrigeration
iv) Dairy process plant
v) Cooling towers performance and selection
vi) Types of condensers and evaporators
