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Total No. of Questions: 09 **Total No. of Pages: 02**

B. Tech. (ME) (Sem. 7, 8)
REFRIGRATION AND AIR CONDITIONING
Subject Code: BTME-802
Paper ID: A3063

Time: 3 Hrs. **Max. Marks: 60**

INSTRUCTIONS TO CANDIDATES:

1. **Section A is COMPULSORY consisting of TEN Questions carrying TWO marks each.**
2. **Section B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **Section C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION A

1.

a) Enumerate the main components of domestic refrigerator.

b) Differentiate between refrigerator and a heat pump.

c) Define relative COP.

d) Explain the necessity of aircraft refrigeration.

e) Define relative COP.

f) Explain the effect of discharge pressure on COP of vapour compression refrigeration system.

g) Define zoetrope's. Give examples of commonly used zoetrope's in refrigeration and air conditioning equipment.

h) Explain the working principle of thermoelectric refrigeration system.

i) Define bypass factor of a cooling coil.

j) Enumerate human requirements of comfort.

SECTION B

2. Explain the working principle of Vortex tube refrigeration system with the help of a neat sketch.

3. A dense closed cycle refrigeration system working between 4 bar and 16 bar extracts heat at the rate of 126 MJ /hour. The air enters the compressor at 5 °C and expander at 20 °C. Assuming that the unit runs at 300 rpm, determine: power required to run the unit, COP of unit, bore of compressor, refrigeration capacity in TR. The expander and compressor are double acting and stroke for compressor and expander is 300 mm. The mechanical efficiency of the compressor is 80%. The mechanical efficiency of expander is 85%. Assume that the compression and expansion are isentropic.

4. An NH_3 refrigerating machine operates between temperature limits of 35°C and -15 °C. Assume two cases: (a) Dry compression (b) Wet compression. Calculate for each case: Theoretical piston displacement per TR, theoretical horsepower per TR, COP.

5. A restaurant with a capacity of 100 persons is to be air conditioned with the following conditions: Outside: 30°C DBT, 70% R.H.; Desired inside conditions: 23°C DBT, 55% R.H.; Quantity of air supplied: 0.5 m^3/min/person. The desired condition is achieved by cooling and dehumidification and then by heating. Determine the capacity of cooling coil in tons of refrigeration, capacity of heating coil, amount of water removed m dehumidifier, BF of heating coil if its surface temperature is 35°C.

6. Explain the working of Electrolux vapour absorption refrigeration system giving a neat sketch.

SECTION C

7.

a) A reversed Carnot cycle working as heat pump is delivering 40000 kJ/min to heat the conditioned space & maintaining it at 25° C when the outside temperature of atmosphere is 15° C. Determine the heat absorbed from the atmosphere air and the power required to operate the cycle. If the same space is to heated by electric coil heaters, determine the power consumed by the electric heater.

b) A refrigeration installation using R-12 comprises one compressor, one condenser and three evaporators with refrigerant flow rates of 2 kg/sec, 5 kg/sec and 3 kg/sec resp. The temperature to be maintained in the evaporators 5°C, 0°C and – 10°C respectively. Each evaporator is fitted with an individual expansion valve & back pressure valves. Condenser pressure is to be maintained at 9.5944 bar. Determine: capacities of different evaporator units, COP of the system. Compare the COP of such a system with single evaporator system.

8.

a) Atmospheric air at 1.0132 bar has a DBT of 32°C and WBT of 26°C. Compute the partial pressure of water vapor, specific humidity, DPT, R.H., degree of saturation, density of dry air in the mixture, density of water vapor in the mixture, enthalpy of the mixture.

b) Explain the methods for detection of leakages in refrigeration and air conditioning systems.

9. The following data refer to summer air-conditioning of a building:
Outside design conditions: 38° C DBT & 27° C WBT, Inside design conditions: 27° C DBT & 21° C WBT, Room sensible heat gain: 46.5 kJ/sec, Room latent heat gain: 17.5 kJ/sec. The air supplies through ventilation and infiltration in the system is 25m^3/min. The outside air to be conditioned is passed through the cooling coil whose ADP is 15° C, while the quantity of re circulated air from the building is 60%. The conditioned fresh air is mixed with recirculated air after the coil. Determine condition of the air after the coil and before the recirculated air mixes with it, condition of air entering the hall, mass of fresh air entering the cooling coil and refrigeration load on the cooling coil.