Roll No. ..... Total Pages : 3

BT-6/M-21 **46209**

REFRIGERATION AND AIR CONDITIONING

Paper–MEP-310A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *five* questions in all, selecting *one* question from each unit.

UNIT–I

1. In an aircraft cooling system, air enters the compressor at 1 bar and 4°C. It is compressed to 3 bar with an isentropic efficiency of 75%. After being cooled to 55°C at constant pressure in a heat exchanger, the air expands in a turbine to 1 bar with an isentropic efficiency of 78%. The low temperature air absorbs a cooling load of 3 tonnes of refrigeration at constant pressure before re-entering the compressor which is driven by the turbine. Assuming air to be an ideal gas, determine the COP of the refrigerator, the driving power required and the air mass flow rate. 15

2. An aircraft refrigeration plant has to handle a cabin load of 30 tonnes. The atmospheric temperature is 17°C. The atmospheric air is compressed to a pressure of 0.95 bar and temperature of 30°C due to ram action. This air is then further compressed in compressor to 4.75 bar, cooled in the heat exchanger to 67°C, expanded in a turbine to 1 bar and then

supplied to the cabin. The air leaves the cabin at a temperature of 27°C. The isentropic efficiencies of both compressor and turbine are 0.9. Calculate the mass of air circulated per minute and the COP.

For air, C_p = 1.004 kj/kg K and C_p/C_v = 1.4 15

UNIT–II

3. A vapour compression system with ammonia as the refrigerants works between the pressure limits of 2 bar and 12 bar with three stage compression. The vapours leaving the water intercoolers at pressure 4 bar and 8 bar are in a saturated state. If the load is 10 TR, find the power required to drive the three compressors and compare the COP of this system with that of a simple saturation cycle working between the same overall pressure limits. 15

4. (a) What is the function of flash chamber provided in a compound vapour compression refrigeration system? 5

(b) Derive the expression for maximum COP of Lithium-bromide water absorption system and explain its working. 10

UNIT–III

5. (a) Establish the following expression for air-vapour mixture :

Specific Humidity, $W = 0.622 \times \frac{p_v}{p_b - p_v}$

Where, p_v = partial .pressure of water vapours

p_b = barometric pressure 8

(b) With the help of psychrometric chart explain heating and dehumidification process. 7

6. 1 kg of air at 20°C dry bulb temperature and 40% relative humidity is mixed adiabatically with 2 kg of air at 40°C dry bulb temperature and 40% relative humidity. Find the specific humidity and enthalpy of the final condition of the air. 15

UNIT–IV

7. (a) Explain solar heat gain through glass windows and why it is taken into account? 7

(b) Describe the transport air-condition in details. 8

8. The outdoor summer design condition for a bank for 100 persons at a place is 35°C dry bulb temperature and 24°C wet bulb temperature. The required inside conditions are 24°C dry bulb temperature and 50% relative humidity. The room sensible heat is 58 kW and the room latent heat is 15 kW. The ventilation requirement per person is 0.54 m^3/min. the by-pass factor is 0.15. Determine : 1. Grand total heat; 2. Effective sensible heat factor; 3. Apparatus dew point temperature; 4. Volume flow rate of dehumidified air. 15