EXERCISE TUTORIAL PROBLEMS

UNIT-I

1. An air refrigeration system works between 2bar and 8 bar. The temperature of air entering the compressor is 70 c & the temperature of air before entering expansion valve is 270 c. expansion and compression follow the law PV1.35 =constant. Find COP of the system.
2. The atmospheric air at pressure 1 bar and temperature -5^0 C is drawn in the cylinder of the compressor of a Bell-Coleman refrigerating machine. It is compressed isotropically to a pressure of 5 bar. In the cooler, the compressed air is cooled to 15^0C, pressure remaining the same. It is then expanded to a pressure of 1 bar in an expansion cylinder, from where it is passed to the cold chamber. Find: (a)The work done per kg of air, and (b)C.O.P. of the plant. (c)For air assume law for expansion $PV^{1.2}$ = constant. Law for compression $PV^{1.4}$ = constant and specific heat of air at constant pressure = 1kj/kg.k.
3. An air craft refrigeration plant has to handle a cabin load of 30 tonnes. The atmospheric temperature is 17^0C. The atmospheric air is compressed to a pressure of 0.95 bar and temperature of 30^0C due to ram action. This air is then further compressed in a compressor to 4.75 bar, cooled in a heat exchanger to 67^0C, expanded in a turbine to 1 bar pressure and supplied to the cabin. The air leaves the cabin at a temperature of 27^0C. The isentropic efficiencies of both compressor andturbine are 0.9. Calculate the mass of air circulated per minute and the C O P forair, cp=1.004kJ/kg K and $\lambda = 1.4$.

UNIT-2

1. In an ammonia vapour compression refrigerator, the temperature of refrigerator is -100 C. The vapour is condensed in a condenser at 300 C. Find the theoretical C.O.P of the cycle when the vapour at the end of compression is 0.9 dry. Take latent heat of NH3 AT 300 C = 1442 KJ/Kg, specific heat of liquid NH3 = 4.7 KJ/Kg.
2. A refrigerator using CO2 as refrigerant works between the temperatures 17.50 C and -17.50 C. The CO2 leaves the compressor at 300 C. The gas is completely condensed but there is no under cooling. Find theoretical COP.
3. In an ammonia vapour compression refrigerator, the temperature of refrigerator is -100C. The vapour is condensed in a condenser at 300C. Find the theoretical C.O.P of the cycle when the vapour at the end of compression is 0.9 dry. Take latent heat of NH3 AT 300 c = 1442 KJ/Kg, specific heat of liquid NH3 = 4.7 KJ/Kg

UNIT-3

1. Single stage reciprocating compressor is required to compress 1.5 m /min if vapour refrigerant from 2 bar to 8 bar, find the power required to drive the compressor, if the compression of refrigerant is (i) Isothermal , (ii) polytropic index as 1.21 and (iii) isentropic with index as 1.31.
2. A single stage single acting reciprocating compressor has a bore of 200mm and a stroke of 300mm. It receives vapour refrigerant at 1bar and delivers it at 5.5 bar. If the compression and expansion follows the law pv1.3=Constant and the clearance volume is 5 percentage of the stroke volume, determine (i) The power required to drive the compressor, if it runs at 500rpm (ii) The volumetric efficiency of the compressor..

UNIT-4

1. The equilibrium concentration of steam jet refrigeration system is 40 parts per 1000 parts of water. The water is supplied to the system with a rate of 25000 Kg/hr. The salt concentration in the supply water is 20 parts per 1000 parts. Find the rate of supply of cold water.
2. a) In an absorption type refrigerator, the heat is supplied to NH3 generator by condensing steam at 2 bar and 90% dry. The temperature in the refrigerator is to be maintained at -50c. find maximum possible COP. If the refrigeration load is 20tonnes and actual COP is 70% of the maximum COP, find the mass of steam required per hour. Take temperature of the atmosphere is 300c.

UNIT-5

1. An air-water vapour mixture enters a heater-humidifier unit at 80 C, 110 kPa, 45% RH. Find i) The relative humidity at the outlet, and ii) The rate of heat transfer to the unit.
2. 30 m3 /min of moist air at 150 C DBT and 130 C WBT are mixed with 12 m3 /min of moist air at 250 C DBT and 180 C WBT. Determine DBT and WBT of the mixture assuming the barometric pressure is one atmospheric. Use psychrometric chart.
3. Atmospheric air at 101.3 kPa, 22 C, 65 percent relative humidity, is to be used to cool a transformer. The transformer dissipates heat at a rate of 230 MJ/h. To increase the cooling effect per kilogram of dry air and thereby decrease the amount of air needed, the air is first adiabatically saturated with water and then passed over the transformer. If the temperature of the air leaving the transformer should not exceed 320C, determine the required flow rate in kilograms of dry air per hour both with and without the adiabatic saturation of the incoming air.
4. Atmospheric air at 101.3 kPa, 220C, 65 percent relative humidity, is to be used to cool a transformer. The transformer dissipates heat at a rate of 230 MJ/h. To increase the cooling effect per kilogram of dry air and thereby decrease the amount of air needed, the air is first adiabatically saturated with water and then passed over the transformer. If the temperature of the air leaving the transformer should not exceed 320C, determine the required flow rate in kilograms of dry air per hour both with and without the adiabatic saturation of the incoming air.
5. In an absorption type refrigerator, the heat is supplied to NH3 generator by condensing steam at 2 bar and 90% dry. The temperature to be maintained in the refrigerator is – 50 C. The temperature of the atmosphere is 300 C. Find the maximum possible COP of the refrigerator. If the refrigeration load is 20 tons and actual COP is 70% of maximum COP. Find the mass of steam required per hour.

UNIT-6

1. a) An air conditioning space is maintained at 260 C DBT 50% RH when the outdoor conditions are 350 C DBT and 280 C WBT. The space has a sensible heat gain of 17.6 KW and the air to the space is supplied at a condition of 80 C saturated. Determine (i) the mass and volume flow rate of the air supplied (ii) latent heat load in the room (iii) The cooling load of the refrigeration plant if 15% of total mass of air supplied to the space is fresh air and the remaining air is re circulated.
2. An ejector refrigeration unit is to be designed to deliver 150 kg per minute of chilled water at 40C from supply water at 220C. Water vapour entering the ejector has a quality of 0.97. Determine i) Volume of flashed vapour removed per minute from flash chamber. ii) Refrigeration capacity of the unit.
3. An air conditioning plant handles 4000m3/min. of dry air which contains 20% fresh air at 390 c DBT & 200c WBT & 80% recirculated air at 240c DBT, 50% RH. Air leaves the cooling coil at 120c & saturated condition. find i) Total cooling load on the coil & ii) Room heat gain.