December 2022

B.Tech. (ME) 5th Semester

Refrigeration and Air- conditioning

(PCC-ME-504-21)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) What are principles of air distribution? (1.5)
   (b) What is Aspect ratio? (1.5)
   (c) What is Cascade refrigeration system? (1.5)
   (d) What is Contact factor for cooling coils? (1.5)
   (e) What is the role of Hydrogen in vapour absorption refrigeration system. (1.5)
   (f) Differentiate between relative humidity and specific humidity. (1.5)
   (g) What is Gross Sensible Heat factor? (1.5)

(h) What is wet-bulb temperature? (1.5)

(i) What is motive steam? (1.5)

(j) Differentiate between COP of refrigeration and COP of Heat Pump. (1.5)

PART-B

2. (a) How the refrigerants are classified? Discuss briefly the factors affecting the choice of refrigerants commonly used in refrigerating plants. (5)

(b) The following data refer to a reduced ambient refrigeration system :

Ambient pressure = 0.8 bar,

Pressure of ram air = 1.1 bar,

Temperature of ram air = 20°C,

Pressure at the end of main compressor = 3.3 bar,

Efficiency of main compressor = 80%,

Heat exchanger effectiveness = 80%.

Pressure at the exit of the aux. turbine = 0.8 bar,

Efficiency of auxiliary turbine = 85%,

Temperature of air leaving the cabin = 25°C,

Pressure in the cabin = 1.013 bar,

Flow rate of air through cabin = 60 kg / min.

Find :

(i) Capacity of the cooling system required;

(ii) Power needed to operate the system; and

(iii) C.O.P. of the system. (10)

3. (a) Compare to multi-evaporator and single compressor systems with multi-evaporator and multiple compressors system with suitable diagrams. (5)

(b) A vapour compression refrigerator works between the pressure of 4.93 bar and 1.86 bar. The temperature of vapour leaving the compressor is 25°C. The liquid is cooled to 9°C before throttling. The vapour is 95% dry before compression. Using the data below, find the COP of the refrigerator. The specific heat at constant pressure for superheated vapour is 0.65 kJ/kg-K and for liquid 0.97 kJ/kg°C. (10)

Pressure (bar)	Temp. °C	h_f (kJ/kg)	h_{fg} (kJ/kg)
4.98	14.45	49.22	148.3
1.86	–15	21.74	162

4. (a) What is steam jet refrigeration system? What are the advantages and disadvantages of steam jet refrigeration system over other types of refrigeration system? (5)

(b) Draw a neat diagram of Lithium bromide water absorption refrigeration system and explain its working. List out the major fields of applications of this refrigeration system. (10)

5. (a) A sling psychrometric reads 44°C DBT and 30°C WBT, calculate the following :

(i) Specific humidity.

(ii) Relative humidity.

(iii) Dew-point temperature

(iv) Enthalpy of mixture. (5)

(b) What is the purpose of Ventilation? What are the different factors which must be considered while evaluating cooling load? What are the different means by which this load can be reduced? Discuss the conditions of comfort you would prescribe for office building in a city like Madras which has hot and humid climate. (10)

6. (a) Explain the Equal friction method for duct design and compare it with Velocity method. (5)

(b) Explain the working of Thermostatic Expansion Valve (TEV) and discuss the Advantages, disadvantages and applications of TEV. (10)

7. An air conditioned space is maintained at 25°C DBT and 50% RH. The outdoor (15) conditions are 40°C DBT and 25°C WBT. The sensible heat load in the space is 24.5 kW. The air supplied to the conditioned space as saturated air at 10°C and the equipment consists of an air washer. The air entering the air washer contains 25% outdoor air and 75% re-circulated air. Determine (a) volume of air supplied to the space per minute, (b) latent heat load in the space, (c) cooling load of air washer.
