Printed pages: 03 Sub Code: NME 604

Paper Id: 140610 Roll No:

B. TECH.
(SEM–VI) THEORY EXAMINATION 2017-18
REFRIGERATION & AIR CONDITIONING

Time: 3 Hours Total Marks: 100

1. Attempt all Sections. If require any missing data; then choose suitably.
2. ***Use of steam tables, refrigerant's property tables and charts, psychrometric charts, and Enthalpy-concentration diagram is allowed.***

SECTION-A

1. Attempt ***all*** questions in brief. **(2x10=20)**

(a) Define Refrigeration.
(b) Differentiate between Refrigerator and Heat-pump.
(c) Give advantages of Vapor compression refrigeration system.
(d) List the advantages of Cascade system over single stage Vapor compression refrigeration system.
(e) Draw the schematic diagram of simple vapor absorption refrigeration system.
(f) What is an Azeotrope?
(g) Give chemical name of R-112.
(h) Define BPF and SHF.
(i) What is Duct? Why is it used?
(j) Define Dew point temperature.

SECTION-B

2. Attempt any three part of the following: **(10x3=30)**

a. In a refrigerator working on Bell-Coleman cycle, air is drawn into the cylinder of the compressor from the cold chamber at 1 bar and -30C. After reversible adiabatic compression to 5 bar, the air is cooled at constant pressure to a temperature of 170C, after subsequent polytropic expansion (pv1.25=C) to 1 bar in the expansion cylinder, the air is passed to the cold chamber. Sketch the p-v and T-s dig of the cycle and determine for unit mass flow of the air:
  i. Refrigeration effect
  ii. Work expended and
  iii. COP

b. The following data refer to a two stage compression ammonia refrigerating system with water intercooler. Condenser pressure=14 bar, evaporator pressure=2 bar, intercooler pressure=5 bar, load on the evaporator=10 TR. If the temperature of de-superheated vapor and sub-cooled liquid refrigerant are limited to 300C, find: (a) the power required to drive the system and (b) COP of the system. Use p-h chart.

c. Draw and explain practical vapor absorption refrigeration system.

d. The atmospheric air at 300C DBT and 75% RH enters a cooling coil at the rate of 200 m3/min. The coil dew point temperature is 140C and BPF of the coil is 0.1. Determine the (i) Temperature of the air leaving the cooling coil, (ii) The capacity of the cooling coil in TR and KW, (iii) The amount of water vapours removed per min and (iv)Sensible heat factor for the process.

e. What are different types of expansion devices generally used in refrigeration system? Describe Thermostatic expansion valve with neat sketch.

3. Attempt any *one* part of the following: 10 x 1 = 10

a. In an aircraft refrigeration unit of a cooling load of 12 TR, the atmospheric temperature and pressure are 120C and 0.9 bar respectively. This pressure increases to 1.01 bar due to ramming effect. The air is bled from the engine compressor at 3.5 bar and passed through the air cooled heat exchanger where its temperature is reduced by 500, the air is then expanded in the cooling turbine, delivered to the aircraft cabin and subsequently leaves the aircraft at 200C. The pressure in the cabin is 1.03 bar. Calculate the power required to undertake the cooling load and COP of the system.

b. A 15 ton aircraft refrigeration plant operates on Boot-strap cooling system. The conditions of ambient air are 170C and 0.95 bar. Due to isentropic ramming action, the pressure of air is increased to 1.2 bar. The pressures of air discharge from main compressor and auxiliary compressor are 3.2 bar and 4.2 bar respectively. 15% of the enthalpy of air discharged from main compressor is removed in the first heat exchanger and 35% of the enthalpy of the air discharged from the auxiliary compressor is removed in the second heat exchanger using rammed air. Subsequently, the air is expanded in the turbine with 85% isentropic efficiency and discharged into the cabin at 1.013 bar pressure. The air is finally exited to the atmosphere at a temperature which is not to exceed 250C. Assuming the isentropic efficiency of both the compressors 80%, determine (a) power required to take the cabin load (b) COP of the system.

4. Attempt any *one* part of the following: 10 x 1 = 10

a. A vapour compression refrigerator uses R-40 and operates between temperature limits of -10 and 450C. At entry to the compressor, the refrigerant is dry saturated and after compression it aquires a temperature of 600C. Using properties from the table, find the COP of the refrigerator.

b. The following data refer to a two stage compression ammonia refrigerating system with water intercooler. Condenser pressure=14 bar, evaporator pressure=2 bar, intercooler pressure=5 bar, load on the evaporator=10 TR. If the temperature of de-superheated vapor and sub-cooled liquid refrigerant are limited to 300C, find:
(a) the power required to drive the system
(b) COP of the system. Use p-h chart.

5. Attempt any *one* part of the following: 10 x 1 = 10

a. Explain advantages of vapour absorption refrigeration system.
A geothermal well at 1300C supplies heat at the rate of 100500 kJ/hr to an vapor absorption system. The environment is at 300C and the refrigerated space is maintained at -220C. Determine the maximum possible heat removed from the refrigerated space. With the help of psychrometric chart, explain following processes:
Cooling and adiabatic humidification process
(ii) Adiabatic mixing of two air streams

b. Describe Electrolux refrigeration system with the help of neat sketches.

6. Attempt any *one* part of the following: 10 x 1 = 10

a. In an air-conditioning system, the inside conditions are DBT 250C, RH 50% and outside conditions are DBT 400C and WBT 270C. The room sensible heat factor is 0.8. 50% of the room air is rejected to atmosphere and an equal quantity of fresh air is added before air enters the air-conditioning apparatus. If the fresh air added is 100 m3/min, determine:

I. Room sensible and room latent heat load
II. Sensible and latent heat load due to fresh air
III. Apparatus dew point temperature
IV. Humidity ratio and DBT of air entering air-conditioning apparatus

Assume BPF as 0 and density of air 1.2 kg/m3 at a total pressure of 1.01325 bar.

b. With the help of psychrometric chart, explain following processes:

I. Sensible heating and sensible cooling processes
II. Cooling and dehumidification process

How are refrigerants classified? What are the desirable properties of refrigerants? Name some common refrigerants generally used in refrigeration system?

7. Attempt any *one* part of the following: 10 x 1 = 10

a. Describe a cold storage in brief. What factors are considered in design of a cold storage?

b. A rectangular duct section of 500 X 350 mm2 size carries 75 m3/min of air having density of 1.15 kg/m3. Determine the equivalent diameter of a circular duct if (a) the quantity of air carried in both the cases is same; (b) the velocity of the air in both the cases is same. If f=0.01 for sheet metal, find the pressure loss per 100m length duct.