Code: 9A03604

R09

B.Tech III Year II Semester (R09) Supplementary Examinations December/January 2014/2015

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

Use of steam tables, P-H charts and Psychrometric charts are permitted in the examination hall

*****

1 (a) Discuss the merits and demerits of the closed cycle and open cycle air refrigeration system.

(b) A food cold storage is using air cycle refrigeration system. The capacity of the cold storage is 140 kW. The temperature of air entering the compressor is 7^oC. The temperature of the air entering the expander is 27^oC. The power required is 25% more than the theoretical power.

Calculate: (i) The actual C.O.P of the cycle. (ii) Power required for the compressor. Assume mass flow rate in the evaporator is 1.5 kg/sec. The index of compression and expansion η = 1.3, V_p = 1.005 kJ/kg^oC and γ =1.4 for air.

2 (a) Sketch the T-S and P-h diagrams for the vapour compression refrigeration system when the vapour after compression is (i) dry saturated and (ii) wet.

(b) What is sub cooling and super heating? Explain with the help of diagrams. Why is superheating considered to be good in certain cases?

3 (a) Define a refrigerant. How are refrigerants classified?

(b) Differentiate between primary and secondary refrigerants.

4 (a) What is the basic function of a compressor in vapour compression system? How this function is achieved in vapour absorption refrigeration system?

(b) In a vapour absorption refrigeration system heating, cooling and refrigeration takes place at the temperatures of 100^oC, 20^oC and -5^oC respectively. Find maximum C.O.P of the system.

5 A steam ejector water vapour system is supplied with motive steam at 7 bar and in saturated condition when the water in the flash chamber is at 5^0C. Make-up water is supplied to the cooling system at 17^0C and condenser is operated at 5 cm of Hg absolute. The nozzle efficiency is 88%, the entrainment efficiency is 65% and thermo-compressor efficiency is 80%. The quality of the motive steam and flashed vapour mixed together at the beginning of compression is 92% dry. Determine: (i) Mass of motive steam required per kg of flashed vapour.

(ii) Refrigeration effect per kg of flash vapour.

(iii) Mass of motive steam required per ton of refrigeration per hour.

(iv) Quality of flashed vapour from flash chamber.

Contd. in page 2

6 (a) Write a short note on by-pass factor for cooling coils.

(b) The sensible heat load factor (SHF) of an air-conditioned room is 0.67. The condition of the air leaving the air-conditioned room is 27^0C DBT and 52% R.H. The maximum permissible temperature difference between the inlet air and outlet air is 11^0C. If the quantity of air flow at the inlet of the room is 180 m^3/min, then find the sensible heat load and latent heat load of the air-conditioned room.

7 (a) What are the different methods used to remove the odours from the air? Explain any one of them in detail

(b) In a cooling application, moist air enters a refrigeration coil at the rate of 100 kg of dry air per minute at 35^0C and 50% RH. The apparatus dew point of coil is 5^0C and by-pass factor is 0.15. Determine the outlet state of moist air and cooling capacity of coil in TR.

8 It is required to design an air conditioning plant for a small office room for following winter conditions:
Outdoor conditions = 14^0C DBT and 10^0C WBT
Required conditions = 20^0C DBT and 60% RH
Amount of air circulation = 0.30 m^3/min/person
Seating capacity of office = 60
The required condition is achieved first by heating and then by adiabatic humidifying. Determine the following: (i) Heating capacity of the coil in kW and the surface temperature required if the bypass factor of coil is 0.4. (ii) The capacity of the humidifier.
Solve the problem by using psychrometric chart.

*****