Roll No. | | | | | | | | |

B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, NOV / DEC 2012

Mechanical Engineering

VII Semester

22

ME 9037 : Refrigeration and Air conditioning

(Regulation R 2008)

Time : 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Define Energy Efficiency ratio
2. Write the chemical formula for (i) R601 (ii) R134a
3. How do you select a refrigerant compressor for data centre applications?
4. What are the types of evaporators commonly used in the refrigeration industry?
5. Why solution heat exchanger is installed on the high pressure side of absorption cooling systems?
6. Explain the term "Figure of Merit" applicable to thermoelectric refrigeration systems.
7. Draw the typical summer air-conditioning processes in psychrometric chart.
8. Differentiate clearly between specific humidity and absolute humidity.
9. What is the acceptable level of CO_2 inside a cinema hall and how these levels are maintained?
10. What is the basis of selection of supply air outlet locations with respect to air distribution systems in a conditioned space?

Part – B (5 x 16 = 80 marks)

11. The following data refer to an air conditioning system for 400 capacity theatre. Ambient : T_{db}=313 K, T_{wb}=303 K. Inside T_{db}=295 K and RH = 50 %. Assume solar heat gain is 5 % of the structure heat gain. The wall heat gain = 15,000 kJ/ K-h, Assume there is no other structural heat gain apart from the wall. Heat release per person is sensible 350 kJ/h, latent heat 100 kJ/h, Volume of the theatre 1200 m^3, Ventilation air 10 m^3/person/h, Air leaves the coil ar 9°C. Find the tonnage of the refrigeration system and show the processes on the psychrometric chart. A part of both recirculated air and fresh air are mixed before passing the coil and the mixture leaves at the ADP. The rest make up air is mixed such that it enters the room at 282 K. Also find the amount of air supplied to the room, the fresh air mixed before and after the coil.

12. a) (i) A refrigeration unit is cooling a space to -5°C by rejecting energy to the atmosphere at 20°C. It is desired to reduce the temperature in the refrigerated space to -25°C. Calculate the minimum percentage increase in work required, by assuming a Carnot refrigerator, for the same amount of energy removed (6)

(ii) Explain in brief which refrigerant would you recommend for the each of the following applications and Why? (1) A cold storage plant of 100 TR capacity using absorption cooling system (2) An 800 TR air conditioning plant using centrifugal compressors (3) A small capacity frozen food compartment to maintain -30°C (10)

OR

b) (i) Using both p-h and T-s chart discuss the real vapour compression cycle (6)
(ii) Discuss the following phenomena on the COP and Cooling capacity of an actual vapour compression refrigeration system (1) Wet compression (2) Increase in sink temperature (3) Installation of Liquid sub-cooler (10)

13. a) A two stage ammonia system works between 13 bar and 1.2 bar. The intermediate pressure is taken to be the geometric mean value of the pressure limits. The condensate is subcooled by 5 K in the condenser. The flow rate of ammonia through the evaporator is 1.5 kg/s. Obtain (i) COP (ii) Cooling capacity (iii) Volume handled by LP compressor (iv) Power for the compressor for cases (1) the flash vapour is compressed by an auxiliary compressor (2) with flash inter cooler

OR

b) Explain the working principle of the following with neat schematic (i) Scroll compressors (ii) Evaporative Condenser and (iii) Thermostatic expansion valve.

14. a) Discuss the following processes involving moist air using pschrometric chart (i) Sensible cooling and Heating (ii) Adiabatic saturation (iii) Cooling and dehumidification (iv) Heating and Humidification (v) Mixing of air-streams

OR

b) Air is pre-heated from -5°C dry bulb and 85 % saturation to 23°C dry bulb. It is then passes through an air washer having a humidifying efficiency of 85 % and using recirculated spray water. Calculate the following (i) The relative humidity of the air leaving the washer (ii) The cold water make-up to the washer in kg/s, given that the air flow rate leaving the washer is 2.5 m^3/s (iii) The duty of the pre-heater in kW (iv) The temperature of the air supplied to the conditioned space if the sensible heat losses from it are 24 kW and 20°C dry bulb maintained there (v) The relative humidity maintained in the room if the latent heat gains therein are 5 kW.

15. a) Compare different non-conventional refrigeration systems with respect to its working principle, refrigerant used, applications, performance, economics and environmental advantages for a typical applications

OR

b) State the conditions of the indoor environment that should be satisfied for a person to feel comfortable. Which of these conditions are under the control of the air conditioning system? How can the design Engineer arrange for the other conditions to have values likely to achieve comfort?