Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Examination January 2010

Subject code: 712102 **Subject Name: Advanced Refrigeration**

Date: 22 / 01 / 2010 **Time: 12.00 – 2.30 pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Describe the balancing of vapour compression refrigeration system with suitable example. **06**

(b) Describe desirable properties of an Ideal refrigerant. **06**

Q.2 **(a)** Draw and explain compound compression with multiple expansion valve and flash inter cooling system. **06**

(b) Briefly explain cascade refrigerator system with neat sketch. **06**

OR

(b) In a 12 tonnes refrigeration ammonia plant compression is carried out in two stages with water and flash intercooling and water sub-cooling. Condenser pressure, evaporator pressure and flash intercooling and sub-intercooling pressures are 12 bar, 3 bar, and 6 bar respectively. If the limiting temperature for inter cooling and sub-cooling is 20° C, determine the following: **06**

a) The coefficient of performance of the plant;

b) The power required for each compressor;

c) The swept volume for each if the volumetric efficiency of each of the compressors is 82%.

Q.3 **(a)** What are the characteristics of good lubricant? Also explain various lubrication methods. **06**

(b) Draw a neat diagram of "Electrolux refrigerator" and explain its working principle. What is the important role of Hydrogen in this system? **06**

OR

Q.3 **(a)** What is crystallization and capacity control in vapour absorption system briefly explain it. **06**

(b) In an aqua ammonia absorption refrigeration system of 9 tonnes refrigeration capacity the vapour leaving the generator are 100% pure NH3 saturated at 40°C. The evaporator, absorber, condenser and generator temperatures are – 20°C, 30°C, 40°C and 170°C respectively. At absorber exit (strong solution) the concentration of ammonia in solution is x =0.35 and enthalpy h= 22 kj/kg. At generator exit (weak solution) x =0.1 and enthalpy h= 695 kj/kg. **06**

a) Determine the mass flow rate of ammonia in the evaporator;

b) Carry out overall mass concentration of ammonia in absorber to determine mass flow rates of weak and strong solution;

c) Determine the heat rejection in absorber and condenser, heat added in generator and COP.

Q.4 **(a)** What are the advantages and limitations of steam jet refrigeration system. **06**

(b) A steam ejector of a water vapour system is supplied with a motive steam at 700˚C kPa. dry and saturated condition. Flash chamber water temperature is to be kept as 13˚C (pressure of 0.0015MPa.) Makeup water is supplied at 30˚C. The condenser is operated at 40˚C. (Pressure of 0.0075MPa.)η_n= 90%, η_{comp}= 75%. The quality of motive steam and flash vapour at the beginning of compression is 90% calculate **06**

(1) Motive steam required/kg of flash vapour.

(2)Motive steam required/ton of refrigeration and

(3)Dryness fraction of steam flashed from the flash chamber.

OR

Q.4 **(a)** Briefly explain see beck effects, Thomson effect and peltier effect in connection with thermoelectric refrigeration system. **06**

(b) Discuss in brief Industrial application of heat pumps. **06**

Q.5 **(a)** Describe an expression for COP of an Air Refrigeration system working on reverse brayton cycle. **06**

(b) An aircraft refrigeration plant has to handle a cabin load of 16˚C. The atmospheric air is compressed to a pressure of 0.96 bar and temperature of 29˚C due to ram action. This air is then further compressed in a compressor to 4.8 bar, cooled in a heat exchanger to 66˚C, expended in a turbine to 1 bar pressure and supplied to the cabin. The air leaves the cabin at a temperature of 26˚C. the isentropic efficiencies of both compressor and turbine are 0.9 calculate: **06**

a) The mass of air circulated per minute;

b) COP;

Take for air :Cp = 1.005 kJ/kg K and γ=1.4

OR

Q.5 **(a)** What are the methods of food freezing? Explain with suitable example. **06**

(b) Write and Explain Industrial application of refrigeration system. **06**

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