Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –I Examination Feb. - 2012

Subject code: 711003N **Date: 17/02/2012**
Subject Name: Advanced Refrigeration
Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Refrigerant properties tables and charts (p-h; h-c) are permitted**

Q.1 **(a)** Explain the balance point approach for analysis of Vapour compression refrigerating system and enumerate the same for compressor and condenser sub-systems. **07**

(b) Explain briefly the following methods of food freezing: **07**

(a) Slow or sharp freezing
(b) Quick freezing

Q.2 **(a)** Enumerate the difference between the dual compressor system having Individual expansion valve or multiple expansion valve using neat sketch and p-h diagram. **07**

(b) Calculate the power required by the two compressors in an ammonia system which serves a 250 kW evaporator at -25 ^{0}C. The system uses two-stage compression with inter-cooling and removal of flash gas. The condensing temperature is 35^{0}C. Assume the optimum intermediate pressure for flash chamber as Pi= $\sqrt{Pe \times Pc}$, where Pe and Pc are the pressures at evaporator and condenser respectively. Please draw a schematic diagram of the system and depicts the state points on p-h diagram. **07**

OR

(b) Explain sectionalizing and booster system for Vapour compression system using neat sketch and p-h diagram. **07**

Q.3 **(a)** What is azeotropic refrigerant? Explain a minimum and maximum boiling azeotrope using t-ξ diagram. **07**

(b) A simple air cooled system is used for an aeroplane having a load of 10 TR. The atmospheric pressure and temperature are 0.9 bar and 10^0 C respectively. During ramming, pressure increases to 1.013 bar. In the heat exchanger, the temperature of air is reduced by 55^0 C. The pressure in the cabin is 1.01 bar and the temperature of air leaving the cabin is 25^0 C. Determine: **07**

(i) Power required to take the load of cooling in the cabin;
(ii) COP of the system

Assume that all the expansions and compressions are isentropic. The pressure of compressed air is 4 bar.

OR

Q.3 **(a)** The higher we go, the cooler we find, then why air-crafts are air conditioned when they cruise at an altitude of 8000m. **07**

(b) What are the favorable and unfavorable factors for using R-134a and a mixture of R-290 and R-600a (50%/50%) as an alternative to R-12 in a domestic refrigerator? **07**

Q.4 **(a)** 7 kg of liquid aqua ammonia with a concentration of 0.7 kg of NH_3 per kg mixture at 15^0 C and 7 bar is adiabatically mixed with 0.5 kg saturated liquid aqua ammonia at 100^0 C and 7 bar. Assume steady flow condition determine (a) the mixture concentration (b) the mixture enthalpy (c) the equilibrium temperature of mixture. **07**

(b) Define heat source and heat sink for heat pump system. Enumerate different heat sources and sinks. **07**

OR

Q.4 **(a)** Draw a neat sketch of single effect LiBr-H2O refrigeration system and explain the same using lnP- 1/T diagram. **07**

(b) Briefly explain cascade refrigeration system with neat sketch. **07**

Q.5 **(a)** With neat sketch explain the working of steam jet refrigeration system. **07**

(b) The following data refer to a steam ejector refrigeration system: **07**

Condition of the motive steam: ……8 bar, dry saturated

Temperature of water in the flash chamber:…….5^0 C

Temperature at which make-up water supplied:……..20^0 C

The pressure at which condenser is operated :……0.06 bar

Nozzle efficiency: 86%; Entrainment efficiency: 64%; Compression efficiency: 80%; the quality of stem and flash vapour at the beginning of compression: 90%

Determine the following

(i) Mass of motive steam required per kg of flash vapour

(ii) Refrigerating effect per kg of flash vapour

(iii) COP of the system

OR

Q.5 **(a)** What are the advantages and disadvantages of thermoelectric refrigeration? **07**

(b) A thermoelectric refrigeration system is to operate in an ambient temperature of 313 K. its figure of merit is 0.0036 K^{-1}. Find the minimum temperature that can be achieved by it. **07**

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