GUJARAT TECHNOLOGICAL UNIVERSITY ME - SEMESTER-I(New course) • EXAMINATION – WINTER- 2015

Subject Code: 2711003 Subject Name: Advanced Refrigeration Time:2:30 pm to 5:00 pm Instructions:

Date: 04/01/2016

Total Marks: 70

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) Discuss applications where R-22 refrigerant is widely used. Why it has to be 07 phase out? Suggest eco-friendly alternatives of R-22 refrigerant.
 - (b) Derive an expression for finding out the mass of motive steam required per kg 07 of water vapour produced in the steam jet refrigeration cycle.
- Q.2 (a) Explain the working of regenerative air refrigeration system with a neat sketch 07 and T-s diagram.
 - (b) A boot strap cooling system of 10 TR capacity is required for an aeroplane cabin. The temperature and pressure conditions of the atmosphere are 20°C and 0.85 bar respectively. The pressure of air is increased from 0.85 bar to 1 bar due to ramming action. The pressure of air leaving the main compressor and auxiliary compressors are 3 bar and 4 bar respectively. The isentropic efficiency of both the compressor is 80% and of turbine is 85%. 50% of total heat of air leaving the main compressor is removed in the first heat exchanger and 40 % of total heat of the air leaving the auxiliary compressor is removed in the second heat exchanger.

Assuming that ramming is isentropic and cabin pressure is 0.9 bar and Temperature of air leaving the cabin should not exceed 20° C, find the followings

- (a) Power required to take the load in the cabin
- (b) COP of the system

OR

- (b) Explain the balancing of compressor and capillary tube in VCR system 07 and effects of unbalanced conditions in compressor-capillary tube system
- Q.3 (a) Explain with neat sketch two-stage VCR system employed with flash 07 intercooling and flash gas removal.
 - (b) A single compressor refrigeration system charged with R-22 refrigerant is having three evaporators of capacity 20 TR, 10 TR and 8TR respectively. The system is also having multiple expansion valve and back pressure valves and a common condenser. The temperature in three evaporators is maintained at -10°C, 0°C and 10°C respectively. The condenser temperature is 40°C. The vapor leaving the evaporators is dry and saturated vapor. Assuming isentropic compression determine the refrigerating mass flow rate in each evaporators and COP of system.

OR

- Q.3 (a) Describe cascade refrigeration system with neat sketch. Depicts different state 07 points of cascade system on T-s and P-h diagrams.
 - (b) Calculate the power required by the two compressors in an ammonia system which servers a 250 kW evaporator at -25°C. The system uses two-stage compression with intercooling and flash gas removal. The condensing temperature is 35°C. The intermediate pressure in flash intercooler is equal to

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 $P_i = \sqrt{P_d} P_s$

- **Q.4** (a) Derive an expression for the COP of an ideal vapour absorption system in terms of temperatures (Generator = T_G , Evaporator = T_E ; Condenser and Absorber = T_C)
 - (b) Explain comparison between two Vapour Absorption Refrigeration LiBr-H₂O
 07 Vs NH3-H₂O.

OR

- **Q.4** (a) In an aqua- ammonia absorption refrigeration system of 10TR capacity, the vapours leaving the generator are 100% pure NH₃ having the enthalpy h = 1473 kJ/kg. The evaporator, absorber, condenser and generator temperatures are -20°C, 30°C, 40°C and 70°C respectively. At absorber exit (strong solution), the concentration of ammonia in solution is x = 0.38 and enthalpy h = 22 kJ/kg. At generator exit (weak solution) x = 0.1 and h = 695 kJ/kg. The enthalpy of saturated liquid ammonia after condensation is h = 372 kJ/kg and the enthalpy of ammonia vapour after evaporation at -20°C is 1420 kJ/kg. Determine the following.
 - 1) mass flowrate of ammonia in the evaporator
 - 2) heat rejection in absorber and condenser
 - 3) heat added in generator

4) COP

- (b) Discuss the advantages of VAR system over VCR system. 07
- Q.5 (a) Describe a cold storage. Does it preserve frozen foods only? What factors are 07 considered in the design of the same?
 - (b) Cite few industrial examples where heating and cooling is simultaneously 07 required and explain why "heat pump" is more suitable for such applications.

OR

Q.5 (a) What are the different methods of food freezing? Explain in detail.
(b) Explain the various methods of transport refrigeration.
07
