



Close book exam. Answer all questions. Draw schematic diagram whenever applicable, and clearly state your assumptions. Refrigerants charts and steam tables/chart are permitted

يسمح للطالب باستخدام خرائط التبريد وجداول وخریطة البخار

Name: _____

Question (1) (16 marks)

- (a) List the main advantages and disadvantages of the hermetic compressors?
(b)- A boot strap cooling system is used for an aeroplane to take 10 tons cooling load. The temperature and pressure conditions of atmosphere are 15 °C and 0.9 atm. The pressure of air is increased from 0.9 to 1.1 atm due to ramming action of the plane. Pressure of air leaving the main compressor and auxiliary compressor are 3.2 atm and 4.2 atm respectively. About 55 % of the total of air leaving the main compressor is removed in the first heat exchanger and 30% of the total heat of air leaving the auxiliary compressor is removed in the second heat exchanger using ramming air. Assuming the ramming action is isentropic, determine:
i. H.P. required to take the cabin load,
ii. COP of the system
The required cabin pressure is 1.03 ata and the temperature of air leaving the cabin should not exceed 27°C .

Question (2) (14 marks)

- (b) Draw flow diagram and T-S chart for Regenerative air cooling system
(c) A compression type of refrigeration machine employs NH₃ as a refrigerant has 20 TOR capacity. Saturated vapour comes out evaporator at -15 °C. Saturated liquid leaves condenser at 40 °C. the compressor has four, single acting, cylinders, runs at 900 rpm, Calculate the following:
(i) - Refrigerant mass flow rate, in kg/min
(ii) - Power required to drive the compressor
(iii) - Diameter and stroke of cylinders if D/L=0.8
(iv) - COP and relative efficiency

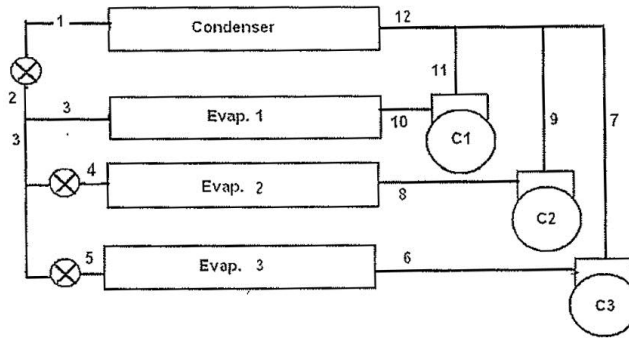
Question (3) (18 marks)

- (a)- Draw flow diagram and p-h chart for single evaporator and three stage compression with flash chamber.
(b)- A cold store building consists of three rooms, requires a refrigeration system of three evaporators with the following specifications:
Evaporator (1) capacity 10 TOR, temperature 10 °C;
Evaporator (2) capacity 30 TOR, temperature 0 °C;
Evaporator (3) capacity 20 TOR, temperature -10 °C;
Condensing temperature 40 °C;
The following assumptions are considered for the unit:

- Isentropic compression,
- Saturation vapour at evaporator outlet;
- Saturation liquid at condenser outlet.

Draw p-h diagram on NH₃ chart and calculate the following:

- Power required to drive the compressors;
- Condenser capacity;
- Unit COP

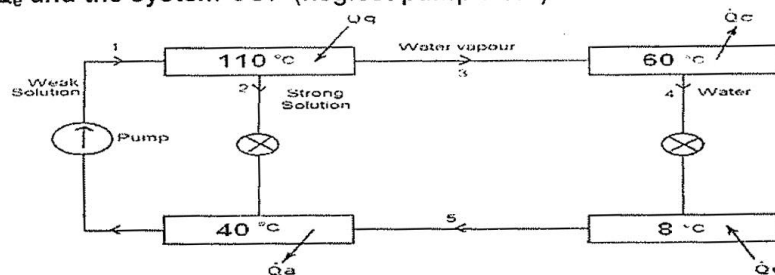


Question (4) (12 marks)

- A simple vapour compression cycle works between fixed pressure limits. List three methods to improve its coefficient of performance?
- A steam jet refrigerator unit is supplied with dry and saturated steam at 5.5 bar. The evaporator pressure is 0.017 bar and steam to vapour ratio is 1.7 to 1. All processes in the nozzle and diffuser are reversible adiabatic. Calculate the pressure to which the jet compressor can discharge

Question (5) (15 marks)

- An aqua-ammonia absorption machine operates at an evaporation temperature of 4 °C and condensing temperature of 35 °C. The following data are given:
 - Heat removed from the condenser is 74.7 kW, Heat removed from the absorber is 138.6 kW, and Heat added to the generator is 142.8 kW,
 Neglecting the pump work done, then determine:
 - The refrigeration capacity of the machine in TOR,
 - Coefficient of performance of the system
 - The generator temperature,
 - Compare the COP with that of simple vapour compression ammonia machine working between the same temperature limits
- Compute the rate of refrigerant (water) through the condenser and evaporator for water-lithium bromide chilled water plant cycle shown in the figure below, if the pump delivers 0.6 kg/s and the operating conditions for cycle are as follows: generator temperature = 110 °C, condenser temperature= 60 °C, evaporator temperature= 8 °C, absorber temperature= 40°C and temperature of solution entering generator = 85 °C. Compute also, for the same system Q_g , Q_a , Q_c , Q_e and the system COP (neglect pump work).



All the best