Kafrelsheikh University
Faculty of Engineering
Dept. Mech. Engineering
Year: 4th Year Mechanical
Subject: Refrigeration & Air Conditioning(MEP4023)

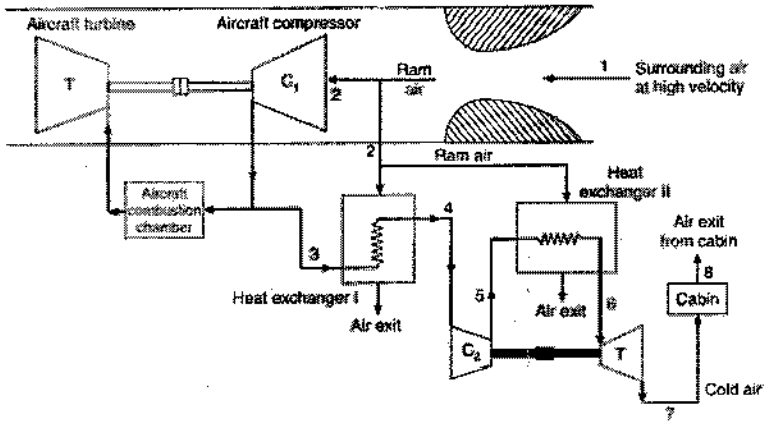
Semester: 1st Semester
Final Exam.
Date: 14 /01/2019
Time allowed: 3 hours
Full Mark: 75

(a) This exam measures ILOs no.: **a.8. a.16, a.19 ,b.7, b.10, b.14, c1, c6,** &c18
(b) No. of questions: 3 - No. of pages: 2
(c) This is a close book exam. ***Non-programmable calculators, Thermodynamics tables, and Steam Chart*** are allowed.
(d) Clear, systematic answers and solutions are required. In general, marks will not be assigned for answers and solutions that require unreasonable (in the opinion of the instructor) effort to decipher.
(e) Ask for clarification if any question statement is not clear to you.
(f) Attempts in all questions.
(g) The weight of each problem is indicated.
(h) **Assume any missing data.**

Question(1) ***(18 marks)***

1-Explain the merits and demerits of the absorption system compared to the mechanical vapour compression
2- Refrigeration system showing the differences between an absorption refrigeration system and a mechanical vapour compression system?
3- Describe with a neat sketch the industrial aqua- ammonia absorption system?
4- What are the desirable properties of refrigerants?
5-What are the desirable properties of refrigerants?

6-For the schematic diagram of bootstrap air craft refrigeration system draw the T.S diagram?



Question(2) ***(18 marks)***

The condenser and evaporator temperatures are 40 °c and –40 °c respectively for a two-stage NH3 refrigeration system of 10 TR cooling capacity. The intermediate temperature is –2 °c. A water intercooler cools the LP vapour to 40 °c. LP vapour is subsequently intercooled up to saturated state in a shell-and-coil

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heat exchanger. The liquid is sub cooled in the same HEX from 40 °c to a temperature of 5 °c. Find the mass flow rates and the swept volume rates and work requirements of both the compressors, condenser heat rejection and COP The clearance volume ratio for both the compressors is 0.04.

Question(3) *(18 marks)*

A steam-jet refrigeration system is supplied motive saturated steam at 6 bar. The temperature of chilled water is 7°C. The ratio of motive steam to flash vapour is 2.5. The condenser pressure is 0.04 bars. Find for 1 T.R. the heat absorbed from the condenser, steam consumption and C.O.P of the unit?

Question(4) *(18 marks)*

An aircraft is flying at a speed of 1000 km/h. The ambient temperature and pressure are –15°C and 0.35 bar respectively. The compressor and turbine and ram efficiencies are 0.8, 0.85 and 0.85 respectively. The pressure ratio of the compressor is 5.0. The heat exchanger effectiveness is 0.8 and the pressure drop in the heat exchanger is 0.1 bar. The cabin pressure is 1.06 bar and the air leaves the cabin at 25°C. Assuming simple aircraft air conditioning cycle, find the temperature and pressure at various state points, COP, mass flow rate, ram work, compressor work, expander work and volume flow rates at turbine and compressor outlets for a 1 TR capacity plant.

Question(5) *(18 marks)*

In a hospital at Kafrelsheikh city, is required to design a cold store consists of two rooms, (A (3x3m) and B(3x4m)) . The store lies in the ground floor, which is 3 m height. Room A is used for storing fresh beef while room B is used for storing fresh vegetables. All Walls, ceiling and floor are common building and insulated with 10 cm expanded polyurethane- aluminum panel (U= 0.227 w/m2 .k). Storing rates is 25% for each room . All rooms are not subjected to solar radiation. Calculate the refrigeration capacity for each room and the power required to derive the compressor considering the system working with R-22 as refrigerant, and the mechanical efficiency is 0.9. Outside condition 37 oc dbt, 25 oc wbt and 21 oc for ground

Inside design conditions and product properties:

Room A storing fresh beef :

T_R = -1.0 °c dbt, 87% R.H, T_1 =37 °c, T_2 =6 °c, C_{P1} = 3.14, C_{P2} = 1.67 kj/kg k, L.H = 228KJ/Kg, T_F = -0.5 °c

Room B storing vegetables:

TR= 2 °c dbt, and 87% R.H, q_{Res} 0.13 w/ kg, T_1 = 26 °c, T_2= 3 °c, τ = 18 hr, C_{P1} = 3.77, C_{P2} = 1,88 kj/kg k, L.H.= 302 kj/kg , T_F = -1 °c , System operating conditions: Evaporating temperature= -8 °c and condenser temperature =43 °c, workers load = 0.275 kw