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

Semester: 1st Semester
Final Exam.
Date: 6 /01/2020
Time allowed: 3 hours
Full Mark: 75

Question(3) *(20 marks)*

1- what are the different types of expansion devices?

2-An aircraft is flying at a speed of 1080 km/h. The ambient temperature and pressure are 2°C and 0.8 bar respectively. The plan uses boot – strap air refrigeration unit to carry a load of 10 T.R. the pressure ratio of the first compressor is 2. After passing through the first heat exchanger, which has 0.5 effectives, the air is again compressed in the second stage compressor which is driven by expander turbine. The cabin pressure is 1.06 bar and the air leaves the cabin at 25°C. 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.

Question(4) *(15 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/m^2 .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. Outside condition 37 °c dbt, 25 °c wbt and 21 °c 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, CP_1 = 3.14, CP_2 = 1.67 kj/kg k, L.H = 228KJ/Kg, T_F = -0.5 °c, air change = 15/ day

Room B storing vegetables:

T_R= 2 °c dbt, and 87% R.H, q_{Res} 0.13 w/ kg, T_1 = 26 °c, T_2= 3 °c, τ = 18 hr, CP_1 = 3.77, CP_2 = 1,88 kj/kg k, L.H.= 302 kj/kg , T_F = -1 °c , air change = 16/ day, System operating conditions: Evaporating temperature= -8 °c and condenser temperature =43 °c, workers load = 0.275 kw

With best wishes Associate Prof. / Fawzy Abou- Taleb , Dr. / Fadl Esssa, and Dr. Fisal Baz

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(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: 4 - 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.**

Answer the following questions:

Question(1)

(20 marks)

1- *Show with neat sketches the methods of i) increasing the refrigeration capacity, and decreasing the power input to the vapor compression system?*
2- *Draw a schematic diagram and the T-S diagram for a vapor compression system used to produce ice?*

3- *Design an optimum refrigeration unit (vapor compression system) of 80 T.R capacity works between 1.8 bars and 14 bars. Then, find the power required and the C.O.P of the system?*

Question(2)

(20 marks)

1- *Draw the h-x chart of a homogeneous binary mixture showing the following processes i) adiabatic mixing of two steams, ii) heating and cooling processes, and iii) throttling process?*
2- *A steam-jet refrigeration system produces chilled water at 7 °c. The ratio of motive steam to flash vapor is 2.5:1. The dry saturated steam enters the steam nozzle at 6 bars. Saturated water leaves the condenser at 0.04 bar Find for 1 T.R, the heat absorbed from the condenser, steam consumption and C.O.P of the unit?*

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