Menoufiya University Faculty of Engineering Shebin El-Kom First Semester Examination Academic Year: 2014-2015	Minufiya University	Department: Mechanical Power Engineering Year: Higher Diploma Subject: Applications of Refrigeration Code: [MPE 507] Time Allowed: 3 hours Date: 11/1/2015

Allowed Tables and Charts: Refrigeration Tables and Charts

Answer the Following Questions [100 Marks]

Question (1) (23 marks)

1-a) Discuss the applications of refrigeration in chemical and process industries. *(5marks)*

1-b) Why is it important to clean the condenser coils of a household refrigerator a few times a year? Also, why is it important not to block airflow through the condenser coils? *(5 marks)*

1-c) A commercial refrigerator with refrigerant 134a as the working fluid is used to keep the refrigerated space at -35 °C by rejecting waste heat to cooling water that enters the condenser at 18 °C at a rate of 0.25 kg/s and leaves at 26 °C. The refrigerant enters the condenser at 1.2 MPa and 50 °C and leaves at the same pressure subcooled by 5 °C. If the compressor consumes 3.3 kW of power, determine *(13 marks)*
   a. The mass flow rate of the refrigerant,
   b. The refrigeration load,
   c. The COP, and
   d. The minimum power input to the compressor for the same refrigeration load.

Question (2) (25 marks)

2-a) Explain how you can reduce the energy consumption of your household refrigerator. *(5 marks)*

2-b) Someone proposes that the refrigeration system of a supermarket be overdesigned so that the entire air-conditioning needs of the store can be met by refrigerated air without installing any air-conditioning system. What do you think of this proposal? *(5marks)*

2-c) It is commonly recommended that hot foods be cooled first to room temperature by simply waiting a while before they are put into the refrigerator to save energy. Despite this commonsense recommendation, a person keeps cooking a large pan of stew twice a week and putting the pan into the refrigerator while it is still hot, thinking that the money saved is probably too little. But he says he can be convinced if you can show that the money saved is significant. The average mass of the pan and its contents is 5 kg. The average temperature of the kitchen is 20 °C, and the average temperature of the food is 95 °C when it is taken off the stove. The refrigerated space is maintained at 3 °C, and the average specific heat of the food and the pan can be taken to be 3.9 kJ/kg · °C. If the refrigerator has a coefficient of performance of 1.2 and the cost of electricity is 10 cents per kWh, determine how much this person will save a year by waiting for the food to cool to room temperature before putting it into the refrigerator. *(15 marks)*

Question (3) (22 marks)

3-a) List the advantages and disadvantages of food freezing process. *(5 marks)*

3-b) What are the properties and types of Packaging Materials used in deep freezers? *(5 marks)*

3-c) A freezing room maintained at -25 °C. Beef of 30 ton at 15 °C to be cooled -25 °C in 16 hr. Thermal properties of Beef are, freezing point is -1.7 °C, latent heat = 231 kJ/kg, specific heat above freezing is 3.43 kJ/kg. K, and below freezing is 1.72 kJ/kg. K. Heat transmission, air change and other appliances loads are estimated to be 6 kW. Estimate the cooling load in TR and assuming safety factor of 10 %. *(12 marks)*

Question (4) (30 marks)

4-a) Explain with brief comment and simple diagram two defrost methods for commercial refrigeration. *(5 marks)*

4-b) List the sources of refrigeration cold storage load. *(5 marks)*

4-c) A freezing room of 10x12x6 m³ at -18 °C receives 30 ton of fish at 25 °C to frozen it to -16 °C in 12 hrs. The room wall consists of 20 cm hall bricks (k=0.813 W/m. K), 7.5 cm cork board (k=0.043 W/m. K), and 5 cm cement layer (k=0.72 W/m. K) at inside and outside. The ceiling consists of 15 cm concrete (k=1.1 W/m. K), 10 cm cork board and 10 cm cement layer. The floor consists of 10 cm concrete, 5 cm cork board and 5 cm cement layer. The inside and outside heat transfer coefficient is 8 and 19 W/m². K. Number of air changes per hour is 1 % of the room volume. The lighting load is 400 W and 5 workers. Calculate the unit refrigeration capacity with 10 % safety factor. *(20 marks)*

With my best wishes