UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 5 Examination in Engineering: June 2015

Module Number: ME 5314   **Module Name: Refrigeration and Air conditioning**

[Two Hours]

[R-134a property charts and Psychrometric chart provided. Answer all questions. Ea ch question carries **five** marks]

Q1. a) State the definition of COP. Imagine a refrigeration machine that can be used both as a refrigerator and a heat pump. Its COP as a heat pump is larger than its COP as a refrigerator. Show this by mathematical derivation.

[1.0 Mark]

b) Compressor is the electricity consuming device in a refrigerator. What is the purpose of the compressor? Also briefly describe the on-off cycle of the compressor.

[1.0 Mark]

c) Show a refrigeration cycle with subcool and superheat states on a **p-h** chart. List the advantages of sub-cooling and superheating of refrigerant.

[1.0 Mark]

d) What do you understand by the term *'global warming potential'* of a refrigerant?

[1.0 Mark]

e) What are the health hazards a refrigerant can cause to the user and neighbours?

[1.0 Mark]

Q2. A vapor-compression refrigeration cycle operates with no-subcool, no-superheat conditions. The refrigerant is **R-134a** that has a mass flow rate of 0.04 kg/s. The low and high pressures are 0.12 MPa and 0.70 MPa respectively.

a) Draw the cycle on the given **p-h** chart.

[1.0 Mark]

b) Assuming isentropic compression, find
- The power input to compressor.
- The rate of heat transfer out of the refrigerated space.
- The rate of heat transfer to the surroundings.
- COP.

[3.0 Marks]

c) If the refrigerant was superheated by 5°C, what would be the cooling capacity?

[1.0 Mark]

Q3. a) What are the four atmospheric conditions which affect human comfort? Explain them briefly.

[1.5 Marks]

b) Considering conditions in (a) define the term " Air Conditioning"

[1.5 Marks]

c) Classify the different air conditioning systems based on function, equipment arrangement and system components.

[2.0 Marks]

Q4. a) Define and explain the following terms

    i)   Relative Humidity
    ii)   Dry Bulb Temperature
    iii)   Wet Bulb Temperature

[1.0 Mark]

b) Atmospheric air at 760 mm of Hg barometric pressure has 25°C dry bulb temperature and 16°C wet bulb temperature. With the help of the Psychrometric Chart, determine following of the air,

    i)   Relative Humidity
    ii)   Humidity Ratio
    iii)   Dew Point Temperature
    iv)   Saturation pressure corresponding to the wet bulb temperature of 16°C.

[4.0 Marks]