(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

THIRD YEAR EXAMINATIONS
FOR THE DEGREE
OF

BSC. FOOD SCIENCE AND TECHNOLOGY

MAIN EXAMINATIONS

COURSE CODE: APT 307

COURSE TITLE: REFRIGERATION, AIR CONDITIONING AND COLD CHAIN MANAGEMENT

DATE:24TH APRIL 2023   **TIME: 12-2 PM**

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Instruction to candidates

- This paper contains SIX questions
- Answer any FIVE questions

MMUST observes ZERO tolerance to Examination Cheating

This paper consists 3 pages Please turnover ➡

ANSWER ANY FIVE QUESTIONS – ALL QUESTIONS CARRY EQUAL MARKS

QUESTION ONE

a) Discuss the major consideration when choosing refrigerants in the refrigeration industry in line with environmental safety.(5 Marks)

b) Working from first principles, show that the CoP of Carnot cycles is entirely a function of temperature limits in the condenser and evaporator. (4 Marks)

c) Given 300kgs of meat in a chiller at initial temperature of 2^0C. The product was frozen and chilled to a final temperature of -10^0C for storage for 8 hours. Compute the product load in kW. The specific heat of poultry above and below freezing are 3.2 and 1.6k J/kgK respectively. The latent heat of freezing is 246 k J /kg and the freezing point temperature is -3^0C. (5Marks)

QUESTION TWO

a) Define Coefficient of Performance (COP) of heat pump in a refrigeration system (1 Mark)

b) Discuss briefly why wet compression is not suitable as working fluid in refrigeration systems. (2 Marks)

c) Discuss using appropriate illustrations, the modifications that could be effected to the isentropic compression and expansion processes of reverse Carnot cycle to make the system operate optimally like the actual refrigeration systems. (6 Marks)

d) The operation temperatures of a single stage vapour absorption refrigerating system are: generator 85^0C; condenser and absorber; 37^0C; evaporator 0^0C. The system has refrigeration capacity of 95kW and the heat input to the system is 155kW. The work of the solution pump is negligible.

   i. Determine the Coefficient of Performance of the system. (2 Marks)

   ii. The total heat rejection rate from the system. (2 Marks)

QUESTION THREE

a) Given two streams of air 1 and 2 flowing in pipes a and b meet at a junction and adiabatically mix to form stream 3 to flow in pipe c. Assume the mass, moisture content, temperature and enthalpy of the of air in stream 1, 2 and 3 are mass- m_1,

m$_2$, m$_3$; moisture content -g$_1$, g$_2$, g$_3$: temperature - t$_1$, t$_2$,t$_3$ and enthalpy - h$_1$, h$_2$, h$_3$ respectively. Show using appropriate formulae that;

  i. For conservation of mass $(g_1-g_3)/(g_3-g_2) = m_2/m_1$ **(2 Marks)**

  ii. For conservation of energy $(h_1-h_3)/(h_3-h_2) = m_2/m_1$ **(2 Marks)**

 b) Discuss using appropriate illustrations cooling and dehumidification process of air conditioning   **(4 Marks)**

 c) Determine the ventilation rate and recirculated-air rates for a factory lobby of 100m^2 for 60 occupancy if smoking is not permitted. An air cleaning devise of efficiency 75% for removal of tobacco is available in the room. The outdoor-air rate requirement for the ventilation is 3.5 litres/second and minimum outdoor rate is per person. **(6 Marks)**

QUESTION FOUR

 a) Discuss how product- process-Package (PPP) principle is used in maintaining the quality and safety of chilled foods. **(6 Marks)**

 a) Discuss the internal and external factors that influence the shelf life of a food material. **(8 Marks)**

QUESTION FIVE
 a) State the principles of Hazard Analysis Critical Control Points and discuss briefly how they are applied in food cold chain management. **(10 Marks)**

 d) Outline the characteristics of a good refrigerant. **(4 Marks)**

QUESTION SIX

Discuss in details citing examples refrigeration and air conditioning control systems. **(14 Marks)**