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University Examinations 2015/2016

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN FOOD SCIENCE AND NUTRITION

AFT 3202: FOOD ENGINEERING

DATE: NOVEMBER 2015   **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) Explain the following terms as applied in unit operations involving food processing:

   (i) Emulsification.   (2 Marks)

   (ii) A unit operation   (2 Marks)

b) Milk is flowing through a full pipe whose diameter is known to be 1.8 cm. The only measure available is a tank calibrated in cubic feet, and it is found that it takes 1 hour to fill 12.4 ft^3. What is the velocity of flow of the liquid in the pipe? Velocity is [L]/[t]:

                                                                              (6 Marks)

c) Explain the laws on which material/mass and energy balances are based.   (4 Marks)

d) Explain any three (3) contact equilibrium processes.   (3 Marks)

e) Highlight five benefits of size reduction during or prior to food processing.   (5 Marks)

f) Explain the procedures for effective plant layout.   (5 Marks)

g) State and explain the mode of action of three types of exchangers.   (3 Marks)

QUESTION TWO (20 MARKS)

a) State and explain the basic theory of heat transfer for two systems brought into contact at two different temperature. (4 Marks)

b) Differentiate between steady and unsteady state of heat transfer. (4 Marks)

c) The wall of a bakery oven built to insulating brick 10 cm thick and thermal conductivity 0.22 $J\ m^{-1}\ s^{-1}\ ^oC^{-1}$. Steel reinforcing members penetrate the brick, and their total area of cross-section represents 1% of the inside wall area of the oven. If the thermal conductivity of the steel is 45 $J\ m^{-1}\ s^{-1}\ ^oC^{-1}$ calculate:

    (i) The relative proportions of the total heat transfer through the wall by the brick and by the steel and (6 Marks)

    (ii) The heat loss for each m^2 of oven wall if the inner side of the wall is at 230^oC and the outer side is at 25^oC. (6 Marks)

QUESTION THREE (20 MARKS)

(a) The thermal conductivity of aluminium if given as 120 $Btu\ ft^{-1}\ h^{-1}\ ^oF^{-1}$. Calculate this thermal conductivity in $J\ m^{-1}\ s^{-1}\ ^oC^{-1}$. (6 Marks)

1 Btu =1055 J

0.3048 m =1 ft

$^oF=(5/9)\ ^oC$

(b) Discuss the role of the following in the refrigeration cycle:

    (i) Evaporator. (4 Marks)

    (ii) Refrigerant. (2 Marks)

    (iii)Compressor. (4 Marks)

(c) State four modes of operation of size reduction plants. (4 Marks)

QUESTION FOUR (20 MARKS)

a) Steam is used for peeling of potatoes in a semi-continuous operation. Steam is supplied at the rate of 4 kg per 100 kg of unpeeled potatoes. The unpeeled potatoes enter system with a temperature of 17^0 C and the peeled potatoes leave at 35^0C. A waste stream from the system leaves at 60^0 C. The specific heats of unpeeled potato, waste stream and peeled potatoes are 3.7, 4.2 and 3.5 kJ/(kg K), respectively. If the heat content of steam is 2750 kJ/kg, determine the quantities of the waste stream and the peeled potatoes from the process.

(8 Marks)

b) Potatoes are dried from 14% total solids to 93% total solids. Calculate the product yield from each 1000 kg of raw potatoes assuming that 8% by weight of the original potatoes is lost in peeling. (8 Marks)

c) Discuss ionic polarization of microwaves. (4 Marks)