2ND SEMESTER 2011/2012

UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAM   :   BACHELOR OF SCIENCE IN FOOD SCIENCE, NUTRITION AND TECHNOLOGY YEAR II

COURSE CODE   :   FSNT 205

TITLE OF PAPER   :   PRINCIPLES OF FOOD ENGINEERING

TIME ALLOWED   :   TWO HOURS

INSTRUCTIONS   :   ANSWER QUESTION ONE (1) AND ANY OTHER TWO (2) QUESTIONS. ILLUSTRATE YOUR ANSWERS WITH DIAGRAMS WHERE NEEDED

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

QUESTION 1 [COMPULSORY]

a. A canned food is thermally treated in a retort whose processing temperature is 131°C. If the initial microbial load is 100 CFU/container and it is desired to reduce it to 10^{-6} CFU/container, calculate the processing time. The target microorganism for this thermal process has a decimal reduction time of 2.5 min for a reference temperature of 121°C, and to reduce the process time to the tenth part (reduce by 90%) it is required to increase the temperature by 10°C. ($j_h = 2$, $f_h = 30$, Initial product temperature is 25 °C).

(15 Marks)

b. Milk with 3.8% fat and 8.1% fat-free solids (FFS) is used for the production of canned concentrated milk. The process includes separation of the cream in a centrifuge and concentration of the partially defatted milk in an evaporator. If the cream that is produced in the centrifuge contains 55% water, 40% fat, and 5% fat-free solids, calculate how much milk is necessary in order to produce a can of concentrated milk that contains 410 g milk with 7.8% fat and 18.1% fat-free solids. How much cream and how much water must be removed in the centrifuge and the evaporator respectively? Assume steady state.   (15 Marks)

c. The wall of an oven consists of two metal sheets with insulation in between. The temperature of the inner wall surface is 200°C and that of the outer surface is 50°C. The thickness of each metal sheet is 2 mm, the thickness of the insulationis 5 cm, and the thermal conductivity is 16 W/m°C and 0.055 W/m°C respectively. Calculate the total resistance of the wall to heat transfer and the heat transfer losses through the wall per m^2 of wall area.   (10 Marks)

[TOTAL MARKS = 40]

QUESTION 2

a. For any stage "i" in *multi-stage co-current extraction system*, write the global, solute and solvent mass balance equation.   (8 Marks)

b. Give a comparative description of contrast gravitational settling and centrifugation operations.   (8 Marks)

c. Give a brief account on the hysteresis phenomena in food materials.   (6 Marks)

d. Explain why one has to be concerned about microorganisms during thermal processing of foods.   (8 marks)

[TOTAL MARKS = 30]

QUESTION 3

a. Outline the advantage of multiple effect evaporation system and show a three-effect forward feed type evaporation system. (8 Marks)

b. Explain the mass transfer phenomena in the constant and falling rate drying period.
(8 Marks)

c. Discuss the principle behind centrifugal separation. (6 Marks)

d. Describe the stages in solid liquid extraction. (8 Marks)

[TOTAL MARKS = 30]

QUESTION 4

a. Describe the lethality in thermal processing of foods. (6 Marks)

b. With the help of graph, explain the constant rate and constant pressure filtration systems. (8Marks)

c. Explain steady and unsteady state system . (6Marks)

d. Define psychrometry and describe the changes of moist air properties during sensible heating and sensible cooling. (10 Marks)

[TOTAL MARKS = 30]