UNIVERSITY OF GHANA

BSC. ENGINEERING

FIRST SEMESTER EXAMINATIONS: 2017/2018

DEPARTMENT OF FOOD PROCESS ENGINEERING

FPEN 201: INTRODUCTION TO FOOD PROCESS ENGINEERING (2 CREDITS)

INSTRUCTIONS: ANSWER SECTION A AND THREE QUESTIONS FROM SECTION B MAKING A TOTAL OF FOUR QUESTIONS

TIME ALLOWED: TWO (2) HOURS

SECTION A (ANSWER ALL)

1. In a plant operation for processing lemons, 1850 kg of lemons were sorted and washed yielding 1750 kg of washed fruits. These were peeled giving 92.5% fleshy fruit. The peels were dried at 85° C for 48 h resulting in 70.5 kg of dried peels. The peeled fruits were processed through a juicer to extract 1,350 kg of juice. The juice was divided into three, A, B. C in the proportion 1:2:3. A was pasteurized and packaged in gallons giving 10 gallons containing 20 kg of juice each; B was concentrated in an evaporator to give 350 kg of concentrated juice and C was processed into marmalade by mixing the juice with 50 kg of sugar, 2.5 kg of pectin and heating at 100° C to yield 550 kg of marmalade.

   a. Draw a complete flow diagram showing materials flow through the process.
   b. Calculate appropriate parameters and do a complete mass balance over the process.

SECTION B (ANSWER THREE QUESTIONS)

2. Energy is very important component in processing and it is used in different forms.

   a. Classify the following processes as work, heat, work and heat, or neither work nor heat. Give reasons for your answer.
      i. The temperature of the air in a room increases because of the sunshine passing through a window.
      ii. A gas cylinder is compressed by a piston and as a result the temperature of the gas rises. The gas is the system.

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iii. When an electric space heater is operating in a room, the temperature of the air goes up. The system is the room.

iv. The same situation as in (iii) but the system is the space heater.

b. Calculate the heat transfer to the atmosphere per second from a circular pipe 5 cm in diameter and 100 m long, carrying steam at an average temperature of 120°C if the surroundings are 20°C? Assume that h = 5 J/(s*m²*C).

c. A 12kg-box of oranges placed on the shelves in a warehouse at a height of 10 m. The box accidentally falls at speed of 3 m/s, and the box topples over a distance of 1.5m on the ground before coming to stop. Estimate the potential energy (in joules) of the box.

3.

a. A cassava processing plant received 7,550 kg of fresh cassava with moisture content of 18.75%.

i. Calculate the total amount of water entering the plant. If all the cassava were used to produce dry cassava chips of 8% moisture, calculate amount of water removed in the drying process.

ii. If the raw materials in the proportion of 55:35:10 for the production of gari, fermented cassava dough and cassava flour respectively, calculate the amount of cassava entering the plant for each stream of product.

b. In the processing of cassava into gari, 10,000 kg of the cassava was peeled before washing. The peeling process yielded 124.6 kg of peels, determine the efficiency of the peeling process, assuming that cassava has 2.65% peels. Comment on the results.

c. What is the role of inoculants in the processing of fermented cassava dough. Describe four methods of inoculant preparation.

4.

a. Food drying is an important operation for ensuring food security. Give the reasons for drying and discuss the general stages of drying.

b. Describe the design of two categories of food driers

c. A sample of yams has a dry basis moisture content of 4.26 grams of water per gram of dry solids. What is its wet basis moisture content?

5. Testing of air has resulted in finding a dry bulb temperature of 30° and a wet bulb temperature of 20°C. Using the appropriate psychrometric chart determine the other properties of the air in this room. If the air in the room was heated to 50°C what will be the properties of air? Discuss the implications of your results.

6. Size reduction of solids in food processing involve grinding and cutting. Discuss the process of grinding and the forces you are likely to encounter. Why are energy requirements for grinding considered important? Discuss the theories for energy requirements in grinding.

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