2 IC 2



# UNIVERSITY OF GHANA



## B.SC FIRST SEMESTER EXAMINATIONS: 2015/2016

## DEPARTMENT OF FOOD PROCESS ENGINEERING

## FPEN 305: ENGINEERING AND DESIGN OF FOOD PROCESS 1 (3 CREDITS)

**INSTRUCTIONS:**

**ANSWER 4 QUESTIONS**

**TIME ALLOWED: 3 HOURS.**

1.

a. In reducing sizes of solid foods, mention and describe the types of forces that are applicable and give example of a food product in which any of these forces is predominantly applied in its size reduction.

b. From the stress and strain diagram in size reduction for various foods, describe the various stages of transformation upon which food undergoes to reach its breaking point.

c. A 10 hp motor is used to mill food from an original particle size of 6 mm to a final size of 0.0012 mm. if the final particle size required is changed to 0.0008 mm, assuming fine grinding, define the law that governs it and use it to calculate:

   i. The amount of power needed to reduce the size from 6 mm to 0.0008 mm
   ii. Determine, in terms of percentage, how much more or less power that would be needed.

2.

a. Describe four factors that affect degree of mixing of food product and also discuss the mixing effect on food

b. In dough forming for bread making describe the three different stages employed and explain the effects of forming on the sensory and nutritional properties of food product

d. During the preparation of dough, 700 g of water are mixed with 100 kg of flour. Ten 100 g samples are taken after 1, 5, and 10 min and analyzed for the % of sugar. The results are as follows.

| Samples | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| % After 1 min | 0.21 | 0.32 | 0.46 | 0.17 | 089 | 1.00 | 0.98 | 0.23 | 0.10 | 0.14 |
| % After 5 min | 0.85 | 0.80 | 0.62 | 0.78 | 0.75 | 0.39 | 0.84 | 0.96 | 0.58 | 0.47 |
| % After 10 min | 0.72 | 0.69 | 0.71 | 0.70 | 0.68 | 0.71 | 0.70 | 0.72 | 0.70 | 0.70 |

Calculate the mixing index for each mixing time and draw conclusions regarding he efficiency of mixing. Assume that for perfect mixing there is a probability that 99.7 % of samples will fall within 3 standard deviation of the mean composition ($\sigma = 0.01\%$). [15 Marks]

3.

a. Explain the term neutral zone and give its significance in relation to the separation of two immiscible liquids using a centrifuge.

b. In separation of two immiscible liquids using a centrifuge, describe the processes in removing;

i. The lighter liquid
ii. The heavier liquid

c. A bowl centrifuge is used to break oil in water. Determine the radius of the neutral zone in order to position the feed pipe correctly. (Assume that the density of the continuous phase is 1000 $kgm^{-3}$ and the density of the oil is 870 $kgm^{-3}$. The outlet radii from centrifuge are 3 cm and 4.5 cm)

4.

a. Describe the theory of filtration and its effect on flow resistance when applied in food process

b. In food filtration process, a higher-pressure difference is needed to maintain the flow rate of filtrate. Describe one filtration equipment;

i. That applies pressure at the filtration side
ii. That applies partial vacuum to the opposite side of the bed

c. Pulp mix contains 15% solids is filtered in a plate and frame filter press with a pressure difference of 290 Pa. The masses of filtrate are shown below for a 1.5 h cycle. Calculate the specific resistance of the cake and the volume of filtrate that would be obtained if the cycle time were reduced to 45 min. (Assume the cake is incompressible and the viscosity of the filtrate is $1.33 \times 10^{-3}$ $Nsm^{-2}$ and the density is $1000 kgm^{-3}$).

| Time (min) | 7.5 | 30.4 | 50.0 | 90.0 |
|---|---|---|---|---|
| Mass of filtrate (kg) | 1800 | 380 | 4900 | 6800 |

5.

a. Compare and contrast a single stage and a double stage expression processes and give two examples of a food products that employs such processes. Give five factors that influence the juice yield from a press.

b. In expression of food product batch and continuous press methods are employed. Describe one batch press equipment in expressing pineapple juice and one continuous equipment in oil extraction.

c. Beer with a specific gravity of 1.042 and viscosity of $1.40 \times 10^{-3}$ $Nsm^{-2}$ contains 1.5% solids, which has a density of 1160 $kgm^{-3}$. It is clarified at the rate of 240 $lh^{-1}$ in a bowl centrifuge, which has an operating volume of 0.09 $m^3$ and a speed of 10 000 $revmin^{-1}$. The bowl has a diameter of 5.5 cm and fitted with a 4 cm outlet. Calculate the effect on feed rate of an increase in bowl speed to 15 000 rev $min^{-1}$, and the minimum particle size that can be removed at a higher speed.