UNIVERSITY OF GHANA

BSC ENGINEERING FIRST SEMESTER EXAMINATIONS: 2016-2017
DEPARTMENT OF FOOD PROCESS ENGINEERING
FPEN 305: ENGINEERING AND DESIGN OF FOOD PROCESSES II (3 CREDITS)

INSTRUCTIONS:

ANSWER FIVE QUESTIONS AT LEAST ONE FROM EACH SECTION

ANSWER THE SECTIONS IN SEPARATE ANSWER BOOKS AS DIRECTED

TIME ALLOWED THREE (3) HOURS

SECTION A (Answer in a separate book)

1.
   a. Food emulsions play critical role in food formulations. Define and explain emulsion instability.
   b. Show how oil or droplet size influence emulsification and relate your explanation to Stoke's Law.

2.
   a. With the aid of a flow diagram, show how instant agglomerated soymilk powders can be manufactured.
   b. Discuss the dispersibility property of instant powders and their influence on the reconstitution of instant powders.
   c. Taking into consideration the reconstitution of instant powders, show the role of disintegration of agglomerates.

3. A food processing plant, which processes 3000 kg of dough a day, has an 80 liters large cake mixer driven by a 380 volt, 3-phase electric motor. The mixer has a power factor (cos ϕ) of 0.84 and a 70% overall mechanical efficiency between the motor and the blades. It effectively mixes a kilogram of dough with 6 watts hours of energy. As the mixing begins, 50 amperes of energy is consumed for the first 8s which rises to 350 amperes. At 350 amperes, it remains steady for 10s before rising to 450 amperes at which level it remains constant throughout the rest of the mixing period.

   Estimate the necessary mixing time for effective mixing of the dough.
   (Assume: Power to the motor = $\sqrt{3}$ EI cos ϕ) where **I** is the current per phase)

SECTION B (Answer in a separate book)

4.

a. With clearly labelled diagrams, describe any two ways of separating solid/liquid mixtures using centrifugation techniques. What design modifications will you include in each situations to promote the smooth discharge of the solid?

b. Discuss with relevant equations how centrifugation effectively separates heavy food material from lighter ones as compared to sedimentation

c. If a cream separator has discharge radii of 5 cm and 7.5 cm, the density of skim milk is 1032 kgm^{-3} and that of cream is 915 kgm^{-3},

   i. Calculate the radius of the neutral zone so that the feed inlet can be designed.

   ii. How significant is the radius of the neutral zone in separating the skim milk from the cream?

5. In the separation of cheese whey into its individual components: fat (1000 nm), protein (2-10 nm), lactose (about 1 nm) and salt (<0.5 nm), ultrafiltration is proposed as the most appropriate technique for separating protein from the other components of the mixture.

a. With the help of a well labelled diagram, design an ultrafiltration process for separating protein from the other components of the whey mixture. What factors will you consider in designing the process?

b. Treating protein as one component of the mixture and all other components as the other component write material balance equations for the three components of the mixture [hint: steam is one of the components]

6.

a. De-acidification and de-alcoholization are routine practices in the food processing industry. Name and describe a suitable method of reducing the alcohol content in vodka from 39% to 12% and increasing the pH of orange juice from 3.8 to 4.6.

b. Discuss the application of irradiation in food processing. Show whether the benefits of food irradiation far exceed its unproven fears.

SECTION C (Answer in the same book as Section B)

7.

a. Draw and label a schematic of a cabinet (tray) drier and a tunnel drier delineating the design and operational differences. In drier designs discuss the attributes of a drying equipment that affect food drying.

b. Discuss the heating mechanisms applicable in food drying and with the aid of appropriate diagrams explain the general stages of drying and their significance