



UNIVERSITY OF GHANA

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BSC. ENGINEERING FIRST SEMESTER EXAMINATIONS: 2018/2019

DEPARTMENT OF FOOD PROCESS ENGINEERING

FPEN 305: ENGINEERING & DESIGN OF FOOD PROCESS I (3 CREDITS)

INSTRUCTIONS: ANSWER FOUR (4) QUESTIONS

TIME ALLOWED: THREE (3) HOURS

1.
 - a. Briefly discuss the operating principles and importance of the following food processing equipment:
 - i. Vapour recompression evaporator
 - ii. Forced circulation evaporator
 - iii. Hammer mill
 - b. One of the non-thermal food preservation methods in the food industry is food irradiation. Discuss the effects of the application of ionizing radiations on food products and their packaging material.
2. In food processing, the acceptability of food products is largely determined by product characteristics including particle size.
 - a. With specific examples distinguish between the direct and indirect methods involved in determining the particle size and particle size distribution of food samples.
 - b. With the aid of detailed sketches, elaborate on the design features, principles of operation and applications of one of the following size reduction equipment; a crusher or a disc attrition mill.
3.
 - a. Distinguish between a spray drier and a fluidized bed drier.
 - b. It is desired to blend corn starch and dried, powdered vegetables for a soup mixture. After 350 s of mixing, the variance of the sample compositions measured in terms of fractional

compositions of starch was found to be 0.0915. How much longer should the mixing continue to reach the specified maximum sample composition variance of 0.018, if the initial proportions of dried vegetable to corn starch were 45:55?

Assume that the starch and the vegetable particles are approximately of the same physical size and that a sample contains 30 particles.

- 4.
- With the aid of diagram(s), describe how instant (agglomerated) soymilk powder is produced.
 - It is desired to dry a 3 kg fruit from a moisture content of 85% to 15% at 100 °C. The fruit has an initial temperature, specific heat capacity and specific gravity of 21 °C, 3.80 kJ/(kg*°C) and 0.983, respectively. Determine;
 - The quantity of heat energy required per unit weight of the original fruit for drying under atmospheric pressure.
 - The energy requirement per kilogram water removed.

Assume that at 100 °C and standard atmospheric pressure, the latent heat of vaporization and specific heat capacity of water are 2,257 kJ/kg and 4.186 kJ/(kg*°C).

- 5.
- Using an example of a food emulsion, describe how stable oil-in-water emulsions are formed.
 - In the food industry, two main classes of emulsifiers are identified. Elaborate on their application in emulsification.
 - Briefly explain the following terms used in emulsification;
 - Emulsion potential
 - Amphiphilic substance
 - Coalescence

- 6.
- Define membrane separation and elaborate on the general permeability equation.
 - With the aid of diagrams, describe the operation and challenges of the following filtration equipment;
 - Rotary drum filter
 - Plate and film filter press
 - What is the centrifugal force acting on a particle in a circular path, if the angular velocity and mass of the particle are 3500 rad/s and 0.045 kg, respectively? Assume the radius of the circular path as 0.3 m.