THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATIONS – 2022

FOOD TECHNOLOGY – SECOND YEAR DEGREE

FT 222 UNIT OPERATIONS I

MONDAY 31ST OCTOBER – 12:50 PM

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES:

1. You have 10 minutes to read the paper. You must not begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS**
3. All answers must be written in the answer books provided.
4. Write your name and number clearly on the front page. **Do it now.**
5. Calculators are permitted in the examination room. Notes and textbooks, laptops and mobile phones are not allowed.
6. Show all workings and calculations in the answer book.
7. ALWAYS start a new question on a new page.

MARKING SCHEME

Question 1	[16 marks]
Question 2	[19 marks]
Question 3	[16 marks]
Question 4	[11 marks]
Question 5	[13 marks]
Question 6	[25 marks]

ANSWER ALL QUESTIONS

1. (a) State the applications of sedimentation. [3 marks]

(b) What does the term terminal velocity mean? [2 marks]

(c) When using Stokes Equation in sedimentation, certain assumptions must be considered. State ALL these assumptions and state the uses of Stokes Equation. [4 marks]

(d) A thickener is to be designed to handle a slurry containing 9.0kg of water per kg of solids. The requirement is to have a sludge with 3.0kg of water per kg of solids in a continuous operation. Laboratory tests show that an average sedimentation rate is $230\mu ms^{-1}$. If the thickener is to have a circular base, estimate the minimum diameter and the area to effect the separation of 8400kg of slurry per hour. State ALL assumptions. [7 marks]

(Total = 16 marks)

2. (a) *FULLY state the definitions of mixing.* [3 marks]

(b) Illustrate the components that are created by a rotating impeller during the mixing of low viscosity liquids. [3 marks]

(c) Answer either (i) or (ii).

(i) Vortexing in mixing of low viscosity liquids has its advantages and disadvantages. Explain. [3 marks]

(ii) Vessels used for low viscosity liquid mixing are recommended to have dished bottom. Why? [3 marks]

(d) In order to stabilize peanut milk produced in FT221 practical, the product (emulsion) must be passed through a homogenizer. Discuss. [4 marks]

(e) Temperature is one of the factors considered when formulating emulsions. Describe its effects and how its upper limit (value) is selected. [3 marks]

(Total = 19 marks)

3. (a) Explain ALL the benefits of size reduction and give detailed description of ANY TWO of these benefits. [5 marks]

(b) Describe and illustrate ALL forms of forces that exist in size reduction. [3 marks]

(c) In terms of stress and strain, describe the behaviour of:

(i) Hard substances. [2 marks]
(ii) Strong substances. [2 marks]
(iii) Weak substances. [2 marks]
(iv) Soft substances. [2 marks]

(Total = 16 marks)

4. (a) Describe the main components of cleaning and sanitation. [3 marks]

(b) Cleaning adds cost to food processing operations. How do food manufacturers control this? [3 marks]

(c) Write notes on 'temperature' and 'mechanical action' in cleaning and sanitation. [5 marks]

(Total = 11 marks)

5. (a) Define crystallization. [2 marks]

(b) FULLY explain how crystallization can be achieved? [4 marks]

(c) Explain the value of super-saturation coefficient "S" in nucleation and its value in relation to concentration of solutions. [3 marks]

(d) State and explain the factors and affect the rate of nucleation. [4 marks]

(Total = 13 marks)

6. (a) Define the following terms:

(i) Extraction. [2 marks]
(ii) Expression. [1 mark]
(iii) Equilibrium stage. [2 marks]

(b) Compare and contrast counter-current and co-current flow of solute in relation to solvent in multi-stage extraction systems. [4 marks]

(c) Describe two-stage-expression detailing its advantages and disadvantages. [3 marks]

(d) Explain the components and the operating mechanism of a roller press. [3 marks]

(e) A multi stage counter-current solid-liquid extraction system consists of 4 equilibrium stages and operates with a constant underflow of 2 kg of solution per kg of insoluble solids. The feed enters stage 1 containing 50% solute and the underflow from that stage contains 40% solute. The overflow from stage 2 contains 43% solute as it exits stage 1 and the rich solution leaving stage 1 contains 60% solute. If all the solute concentrations are measured in (w/w), determine the concentration of solute in the spent cake leaving stage 4. [10 marks]

(Total = 25 marks)

USEFULL DATA

XpA +XpB + XpC=1	$N = -D\frac{dC}{dX}$
$X_B = \frac{k}{(k+1)} - X_A$	$\frac{d_w}{d_t} = DA[C_s - C]$
$X_A = 0,\ X_B = \frac{k}{k+1}$	$F_G = \rho_P V_P . g$
$X_B = 0,\ X_A = \frac{k}{k+1}$	$(Re)p = \frac{\rho_f V_t D}{\mu}$
$V_t = \frac{D^2(\rho_p - \rho_f)g}{18\mu}$	$A_{min} = \frac{S}{\rho_f V_t}$
$S = \rho_f A V$	$A_{min} = \frac{F}{\rho_f V_t}\left[\frac{XS - XF}{XS}\right]$
$A_{min} = \frac{F}{\rho_f V_t}\left[\frac{XU - XF}{XU}\right]$	$S = \frac{F_{XU} - F_{XF}}{XU} = F\frac{XU - XF}{XU}$