Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	SEPARATION ENGINEERING TECHNOLOGY
COURSE CODE	:	DAK 23903
PROGRAMME CODE	:	DAK
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS
		2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

Q1 (a) Distillation is one of the separation techniques in a chemical process.

(i) Define distillation.

(2 marks)

(ii) Explain the relationship of volatility and boiling point.

(2 marks)

(b) An equimolar feed of propane, butane, pentane and hexane is to be separated in a distillation column. 90% of propane from the feed is to be recovered in the distillate. The distillate should not contain more than 10% of butane from the feed stream. Feed stream temperature is 50 °C. Based on Fenske equation,

(i) Calculate the minimum number of stages distillation (*Nmin*).

(6 marks)

(ii) The mole fraction of each component, x_i in the distillate, *D*.

(15 marks)

Q2 (a) Evaporation is one of a mass transfer operation which is different from distillation and boiling process. Explain the difference of evaporation from boiling.

(4 marks)

(b) Sketch a detail diagram for each evaporator below.

(i) Short tube evaporator.

(3 marks)

(iii) Long Tube Vertical evaporator.

(3 marks)

(iii) Forced circulation evaporator.

(3 marks)

(c) Explain the mechanism of evaporation process for all **three (3)** evaporators in **Q2 (b)**.

(12 marks)

Q3 (a) Solid liquid extraction is the process of removing solute from a solid material using a suitable solvent. Explain the term solute and carrier in leaching process.

(4 marks)

(b) In a single stage leaching, soybean oil is extracted from 120 kg solid soybeans using hexane as a solvent. The solid soybean contains 20 wt% oil and 150 kg of fresh hexane solvent is used. The value of N for the slurry underflow is constant at 1.5 kg insoluble solid / kg solution retained.

(i) Calculate the value of x_M.

(3 marks)

(ii) Calculate the amount (kg) of the overflow, V_1 and its compositions, y_1.

(9 marks)

(iii) Calculate the amount (kg) of the underflow slurry, L_1 and its compositions, x_1.

(9 marks)

Q4 (a) Gas absorption is a mass transfer operation where one or more solute gas is removed by dissolution in a liquid.

(i) Explain the term solute, carrier and absorbent in absorption process.

(3 marks)

(ii) Explain how high and low temperatures affect the absorption process.

(4 marks)

(b) A packed tower uses an organic amine to absorb carbon dioxide. The entering gas contains 1.25 mol% CO_2 is to leave with only 0.05 mol% CO_2. The amine gas is pure, without any CO_2 content. Assuming that the amine exits in the equilibrium with the entering gas, it would contain 0.8 mol% CO_2. The gas flow is 2.8 gmol/sec while the liquid flow is 5.3 gmol/sec. The tower diameter is 40 centimeters and the overall mass transfer coefficient, Ky per volume is 5×10^{-5} gmol/cm^3.sec. Calculate the packed tower height, Z.

(18 marks)

– END OF QUESTIONS –