UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	SEPARATION ENGINEERING TECHNOLOGY
COURSE CODE	:	BNQ 30104
PROGRAMME CODE	:	BNN
EXAMINATION DATE	:	JANUARY/FEBRUARY 2021
DURATION	:	3 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) List **FIVE (5)** important steps in designing any equipment required by industry that you learn in Separation Engineering Technology subject.

(5 marks)

(b) Based on the situation listed below, identify **TWO (2)** possible specific reasons for each of the problem and provide a solution to the situation given.

(i) Purified methanol was produced by distilling a water-methanol mixture. However, after the process completed, the sample was analyzed and did not meet the specification needed for purified methanol.

(4 marks)

(ii) During evaporation of a certain solution, the operation suddenly stopped due to the steam supplied failure. In the same time, the engineer observed that the amount of product did not meet the requirement even though the operation is almost complete

(4 marks)

(iii) In an absorber, carbon dioxide needs to be separated from air using water as solvent. The flow is counter current where water flowed downward and the carbon oxide-air mixture was pumped upward. At one point, the water no longer flows downward and was slowly carried upward. Overflows then happened bringing all of the absorber content outside the column.

(4 marks)

(iv) Ahmad wants to extract peanut oil from 1kg of peanut. He was using water as a solvent. He used batch column where he just mixed the peanut with the water. However, after 3 hours, he still did not get any extract from the peanut.

(4 marks)

(c) As an intern student, you are asked to recover some amount of acetic acid that has been accidently mixed with water. Propose the method for the separation process and provide step by step explanation on the recovering process.

(4 marks)

Q2 A single-effect evaporator is concentrating a feed of organic colloids from 5 to 50 wt%. The solution has a negligible boiling-point elevation. The heat capacity of the feed is c_p = 4.06 kJ/kg.K and the feed enters at 15.6 °C. Saturated steam at 101.32 kPa is available for heating, and the pressure in the vapor space of the evaporator is 15.3 kPa. A total of 4536 kg/h of water is to be evaporated. The overall heat-transfer coefficient is 1988 W/m^2.K.

(a) Sketch the process flow diagram and label the process variables.

(5 marks)

(b) Based on the total mass balance, determine the unknown value that flows in and out of the evaporator stream

(5 marks)

(c) Calculate the steam consumption (kg/h), surface area (m^2) and the steam economy in kg vaporized/kg steam Refer **Table Q2(i)** and **Q2(ii)** for properties of saturated steam and water

(15 marks)

Q3 Pure isopropyl ether of 450 kg/h is being used to extract an aqueous solution of 150 kg/h with 30 wt% acetic acid by countercurrent multistage extraction. The exit acid concentration in the aqueous phase is 4 wt%.

(a) Calculate the amounts and compositions of the extract and raffinate phases.

(12 marks)

(b) Plot the graph at the provided phase diagram in **Figure Q3** (Please attach and submit together with the examination answer script).

(8 marks)

(c) Identify the number of stages required based on the liquid-liquid extraction on the phase diagram.

(5 marks)

Q4 A tray tower is to be designed to absorb acetone from a gas stream (acetone+air) by using pure water. The entering gas contains 1 mol% acetone and 90% of the acetone need to be removed. The entering pure water flow rate is 1944 kg H_2O/h and the gas flow rate is 1020 kg gas/h. The equilibrium relation for acetone in the gas-liquid is $y_A = 2.53x_A$ (Mw gas =34 kg/kmol, water =18 kg/kmol).

(a) Sketch the process flow diagram and label the process variables.

(5 marks)

(b) Calculate the outlet composition of the gas.

(10 marks)

(c) Determine the number of stages required graphically and using the analytical Kremser equation.

(10 marks)

- END OF QUESTIONS –

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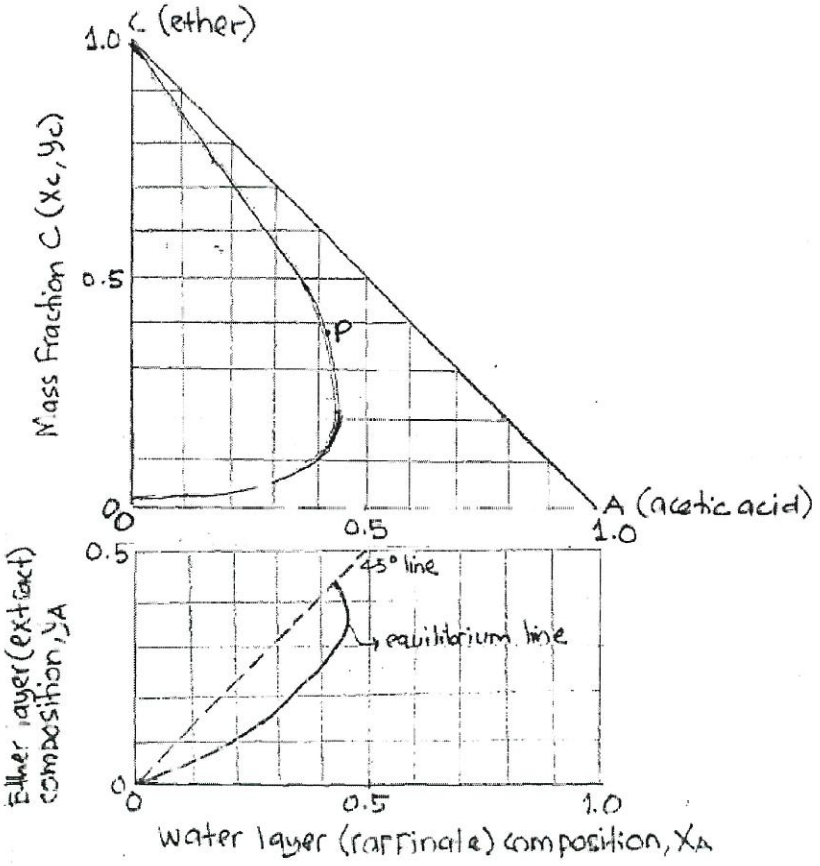

Figure Q3: Graph of liquid-liquid extraction

- Please attach and submit together with the examination answer script-