BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF CHEMISTRY

MAR 2023

Programme: HBScCHT Part 1.2

Course Code: CH116 Fundamentals of Chemical Engineering

Duratiom: Two (2) Hours

ANSWER QUESTION ONE, TWO QUESTIONS FROM SECTION A AND TWO FROM SECTION B. EACH QUESTION CARRIES TWENTY MARK

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Q1 a) What utility streams are represented by the following letters

i. hps
ii. wr
iii. rw
iv. htm
v. bfw

[5 Marks]

b) Give three criteria for choosing a batch process as opposed to a continuous process. **[6 Marks]**

c) Most pharmaceutical products are manufactured using batch processes. Give at least two reasons why this is so. **[4 Marks]**

d) Distinguish a process flow diagram (PFD) diagram of a distillation process from that of a block flow diagram (BFD).

[5 Marks]

SECTION A: ANSWER ANY TWO QUESTIONS

Q2 a) 100 kg ethanol (C_2H_5OH) reacts with 100 kg acetic acid (CH_3COOH) to form ethyl acetate:

$C_2H_5OH + CH_3COOH \rightarrow CH_3COOC_2H_5 + H_2O$

Determine the limiting reagent. **[6 Marks]**

b) 10 kg of 80% NaOH solution was mixed with 15 kg of 40% NaOH solution in a mixer.

i. Draw a block flow diagram for the mixing process.
ii. Calculate the mass of NaOH and water in the streams leaving.

[2+6 Marks]

c) 100 kg of a 50% wt. NaCl solution is mixed with a 10% wt. NaCl solution to produce a solution of 30% wt. Calculate the amount of 10% wt. and 30% wt. solutions. **[6 Marks]**

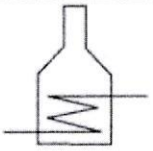
Q3 a) With the help of an illustration, explain the difference between a parallel heat exchanger and a parallel flow heat exchanger. **[8 Marks]**

b) Explain why baffles are installed in tube-shell heat exchangers. **[6 Marks]**

c) What are the causes of poor performance of a heat exchangers? **[6 Marks]**

Q4 a) Explain the importance of P&ID diagrams in a chemical process. **[6 Marks]**

b) What do the following process symbols represent?

			
(i)	(ii)	(iii)	(iv)

[4x2 Marks]

c) Give a reason why the following process equipment are elevated.
i) Columns
ii) Critical fire water tank.

[2x3 Marks]

SECTION B: ANSWER ANY TWO QUESTIONS

Q5 a) State any four considerations for selection of re-boilers. **[8 Marks]**

b) With the help of a diagram, explain the operation of a forced circulation re-boiler. **[6 Marks]**

c) Vacuum distillation unit is a common unit operation of any crude oil refinery.
i. Why are such units important?
ii. Why is the diameter larger than that of an atmospheric distillation column?

[2x3 Marks]

Q6 a) How are industrial absorbers classified? **[6 Marks]**

b) Describe procedure for solving absorption problems using the McCabe graphical method. **[8 Marks]**

c) Explain the Kremser Method for determining the number of plates of an absorption column. **[6 Marks]**

Q7 a) State the steps involved in the design of a heat exchanger. **[12 Marks]**

b) Homogeneous liquid-phase reaction, volume of CSTR (V) = 100 L, feed flow rate (v_o) = 10 L min^{-1}. **[4 Marks]**

c) Explain any difference between residence time (t) and space time (τ). **[4 Marks]**