

**MANICALAND STATE UNIVERSITY OF
APPLIED SCIENCES**

FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL AND PROCESSING ENGINEERING

PROCESS SYNTHESIS

CODE: HCHE 316

SESSIONAL EXAMINATIONS

APRIL-MAY 2021

DURATION: 3 HOURS

EXAMINER: ENG. P. SIGAUKE

INSTRUCTIONS

1. Answer **any four (4)** questions.
2. Each question carry 25 marks .

QUESTION 1

a) Outline the steps in designing /retrofitting a chemical process

[25 marks]

QUESTION 2

a) Consider the separation problem shown in Figure 1, except that separate isopentane and n-pentane products are also to be obtained with 98% recoveries. Use heuristics to determine a good sequence of ordinary distillation units.

[20 marks]

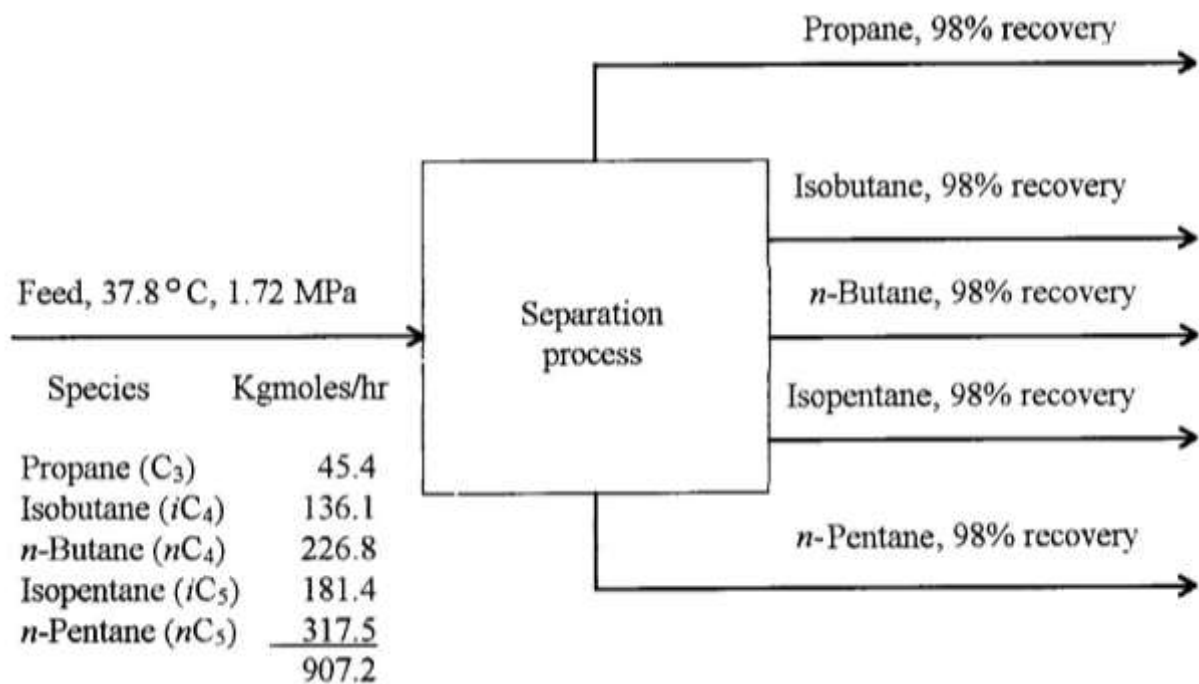


Figure 1: Paraffin Separation Problem

Given data:

<u>Component Pair</u>	<u>Approximate α 1 atm</u>
C ₃ / iC ₄	3.6
iC ₄ / nC ₄	1.5
nC ₄ / iC ₅	2.8
iC ₅ / nC ₅	1.35

b) Outline the main heuristics for distillation sequencing. [5 marks]

QUESTION 3

- a) Explain what you understand by the following terms:
- i) Process synthesis
 - ii) Distillation
 - iii) Objective function
 - iv) Heuristics
 - v) Process flow diagram [10 marks]
- b) Draw and describe the following diagrams:
- i) Block flow diagram [5 marks]
 - ii) Process flow diagram [5 marks]
 - iii) Piping and Instrumentation diagram [5 marks]

QUESTION 4

A feed stream of pure liquid water enters an evaporator at a rate of 0.5 kg/s. Three streams come from the evaporator: a vapor stream and two liquid streams. The flowrate of the vapor stream was measured to be 4×10^6 L/min and its density was 4 g/m^3 . The vapor stream enters a turbine, where it loses enough energy to condense fully and leave as a single stream. One of the liquid streams is discharged as waste, the other is fed into a heat exchanger, where it is cooled. This stream leaves the heat exchanger at a rate of 1500 pounds per hour. Calculate the flow rate of the discharge and the efficiency of the evaporator. [25 marks]

QUESTION 5

- a) Outline the uses of a P&ID diagram. [10 marks]
- b) How are separation units chosen for a particular chemical process. [3 marks]
- c) What are the **three** types of recycle structures possible in a chemical process? Explain when each is used. [6 marks]
- d) What information can be determined using the input/output diagram for a process. [3 marks]
- e) Many companies and municipalities are reluctant to handle chlorine, either in processing or incinerating wastes. Discuss reasons why? [3 marks]

END OF EXAM