



MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, SCIENCE AND TECHNOLOGY

DEPARTMENT: CHEMICAL AND PROCESSING ENGINEERING

MODULE: SEPARATION PROCESSES II

CODE: CHEP 325

**SESSIONAL EXAMINATIONS
JUNE 2023**

DURATION: 3 HOURS

EXAMINER: MISS H TOM

INSTRUCTIONS

- 1. Answer **Question one** and **any other three** questions of your choice.*
 - 2. Start a new question on a fresh page*
 - 3. Total marks 100*
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QUESTION ONE

- (a) Define the concept of separation from a chemical engineering perspective. [2]
- (b) Give four separation techniques that were developed by early civilizations. [4]
- (c) Give brief definitions/descriptions of the following terms.
(i) *Enrichment*
(ii) *Concentration*
(iii) *Purification*
(iv) *Refining*
(v) *Isolation* [5]
- (d) State the physicochemical properties upon which separations are achieved in chemical engineering. [2]
- (e) What is evaporation in terms of separation processes and give an example where it is used in the Chemical industry [2]
- (f) List any **five** products of fractional distillation of Crude oil. [5]
- (g) Ion exchange is a powerful technology and is successfully used in many fields, name **three** fields where it is applied. [3]
- (h) What is the major function of packing in packed tower? [2]

QUESTION TWO

For each of the following binary mixtures, a separation operation is suggested.

Explain why the operation will or will not be successful.

- (a) Separation of air into oxygen-rich and nitrogen-rich products by distillation. [5]
- (b) Separation of m-xylene from -xylene by distillation. [5]
- (c) Separation of benzene and cyclohexane by distillation. [5]

(d) Separation of isopropyl alcohol and water by distillation. [5]

(e) Separation of penicillin from water in a fermentation broth by evaporation of the water. [5]

QUESTION THREE

(a) What is a membrane in relation to membrane separations? [2]

(b) What are the features of membrane separation technologies? [4]

(c) Copy and complete **Table 1**. [5]

Table 1

Types of membrane process	Driving force/gradient	Separation range
	Pressure	10-0.1 μ m
Ultrafiltration		<0.1 μ m-5nm
Reverse osmosis	Pressure	
	Electric field	<5nm
Dialysis		<5nm

(d) Compare and contrast azeotropic and extractive distillation [8]

(e) Crystallisation is one of the oldest unit operations.

(i) Give **three** applications of crystallisation.

(ii) State **three** methods that can be used to achieve the process of crystallisation.

[6]

QUESTION FOUR

(a) What happens in liquid-liquid extraction? [2]

(b) List **three** types of extractors. [3]

- (c) Explain the working mechanism of one of the mentioned extractors above. [5]
- (d) State the **three** main factors that make separation technologies important in the petrochemical industry. [3]
- (e) Distinguish between adsorption and absorption. [10]
- (f) Describe either the Solution-diffusion model or the Hydrodynamic model in membrane separations. [3]

QUESTION 5

- (a) What does it mean by “dead-end” and “cross-flow” in Ultrafiltration processes? [4]
- (b) How does flow direction affects the UF and MF processes? [2]
- (c) Distinguish between Osmosis and reverse osmosis [8]
- (d) What is filtration and what are some of the applications of filtration in the bio-industry? [6]
- (e) List **five** Applications of Chromatography in biotechnology [5]

END OF EXAMINATION