



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL ENGINEERING

CHEMICAL ENGINEERING PACKAGES

ECE 5103

Final Examination Paper

December 2024

This examination paper consists of **three (3)** pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

INSTRUCTIONS

1. Answer **ALL** questions in **SECTION A**
2. Answer **ANY TWO** questions in **SECTION B**
3. Each question carries 25 marks

MARK ALLOCATION

QUESTION	MARKS
1	25
2	25
3	25
4	25
5	25
TOTAL ATTAINABLE MARK	100

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SECTION A:

Answer ALL questions in this section.

Question 1

Impurities in Sugar beets removed by treating raw juice with slaked lime. The slaked lime is bubbled through as well as Carbon dioxide. The solid precipitated contains the vast majority of the impurities and these are filtered. Hexane is used in the process mixed with water from extraction process. The cassava legumes contain the required glucose.

- a) Write the full equation for the reaction of the components.
- b) Describe in full extent the process modelling and simulation using two units using SUPERPRO for batch process operating at 83.3% of the year.
- c) What is the significance of an EIR report and describe how it can generated?

[25]

Question 2

Discuss the importance of model validation and sensitivity analysis in dynamic modeling. What are the methods used to assess the accuracy and reliability of the model predictions? How can sensitivity analysis help identify the most influential parameters or inputs?

[25]

Question 3

At one processing plant, a water scrubber is used to scrub ammonia from a vapor stream with composition (30 % Ammonia, 70 % Air). Using ASPEN describe how the gas and liquid products can be modelled, simulated and validated.

[25]

Question 4

Using SIMSCALE, describe in full how a centrifugal pump can be modelled and simulated. Include all the important steps and relevant inputs.

[25]

Question 5

Explain the concept of coupling CFD and Discrete Element Modelling (DEM). What are the main advantages of using a coupled approach over individual CFD or DEM simulations? Provide examples of applications where coupled CFD-DEM modelling is beneficial.

[25]

END OF QUESTION PAPER