MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING

CHEMICAL AND PROCESSING ENGINEERING DEPARTMENT

PROCESS SYNTHESIS

CODE: HCHE 316

SESSIONAL EXAMINATIONS

DECEMBER 2022

DURATION: 3 HOURS

EXAMINER: ENG. P. SIGAUKE

INSTRUCTIONS

1.   Answer **ALL** questions

2.   Each question carries 25 marks

QUESTION 1

a) Explain what you understand by the following terms: :

(i)   *Process*

(ii)   *Parametric optimisation*

(iii)   *Process modelling*

(iv)   *Process statistics*

(v)   *Process synthesis*   [10]

b) Name five things that would affect the locations of different pieces of equipment when determining the layout of equipment in a process unit   . [5]

c) Describe the *three* basic ways that unreacted raw materials can be recycled in continuous processes   [6]

d) With reference to specific guidelines, describe how separation units are chosen for a particular chemical process.
[3]

e) Why are accurate plant models (made of plastic parts) no longer made as part of the design process? What function did these models play and how is this function now achieved?   [1]

QUESTION 2

a) Explain what you understand by the following terms:

i)   Distillation

ii)   Pinch analysis   [4]

b) What is a flow diagram/flow sheeting?   [2]

c) Highlight the steps involved in developing the flow sheet for a typical process plant.   [3]

d) Draw and describe the following diagrams

i) block flow diagram

ii) process flow diagram

iii) Piping and instrumentation diagram [6]

e) What are the issues which are considered when evaluating process alternatives. [4]

f) Describe the *three* basic ways that unreacted raw materials can be recycled in *Process design* continuous processes
[6]

QUESTION 3

a) Define

   i) *Objective function*

   ii) *flowshop plant*

   iii) *jobshop plant*

   iv) [8]

b) What are the three types of recycle structures possible in a chemical process? Explain when each is used. [6]

c) What information can be determined using the input/output diagram for a process? [3]

d) Many companies and municipalities are reluctant to handle chlorine, either in processing or in incinerating wastes. Discuss reasons why. [2]

e) What process should be used in the separation of toluene (Bp = 110 °C) and benzene (Bp = 79.8°C)? Justify your answer. [3]

f) What are the factors that determine the capital cost of a piece of equipment at a given time? [3]

QUESTION 4

a) Define

i) *heuristics*

ii) *reactive distillation* [6]

b) Give any five heuristics for ethical problem solving. [6]

c) List any 5 heuristics for process synthesis. [10]

d) Why is it important for a process engineer to be able to review a three-dimensional model (actual or virtual/electronic) of the plant prior to the construction phase of a project? [3]

END OF EXAM