



MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING

DEPARTMENT: CHEMICAL AND PROCESSING ENGINEERING

MODULE: COMPUTATIONAL METHODS FOR CHEMICAL ENGINEERS

CODE: CHEP 221

SESSIONAL EXAMINATIONS

DECEMBER 2022

DURATION: 3 HOURS

EXAMINER: MISS N. T. MADZIWA

INSTRUCTIONS

1. Answer **ALL** questions
2. Start a new question on a fresh page
3. Total marks 100

Additional material(s): Calculator

QUESTION 1

- a) Explain the significance of the following diagrams to Chemical Engineers
- i. Block Flow Diagram
 - ii. Process Flow Diagram
 - iii. Piping & Instrumentation Diagram [5]
- b) Explain what a pressure vessel is in relation to equipment in a chemical plant [2]
- i. What are the distinct components of a pressure vessel for design purposes [5]
- c) Explain the following terms when used in Process simulations
- i) Sequential modular
 - ii) Equation-Oriented (Simultaneous-Nonmodular)
 - iii) Simultaneous-Modular [5]
- d) Compare and contrast the services that the Solver and Goal seek functions in Microsoft Excel provide to the application's end users. [3]

QUESTION 2

- (a) A simple system consists of two feed streams (stream 1: toluene; stream 2: benzene) that enter a heater separately and combine into 1 stream to exit. The heater uses high-pressure steam as the utility. Build a simple process flow diagram of the process described above. [10]
- (b) What is the ASME Boiler and Pressure vessel code (ASME BPVC) [2]

- (c) The ASME BPVC is document format that has divisions, sections, subsections and appendices. The commonly applied sections across different industries are section IV to VIII. Describe the content covered in these sections. [8]

QUESTION 3

- a) What errors can you identify or missing information on the following BFD in Fig. 1? [3]

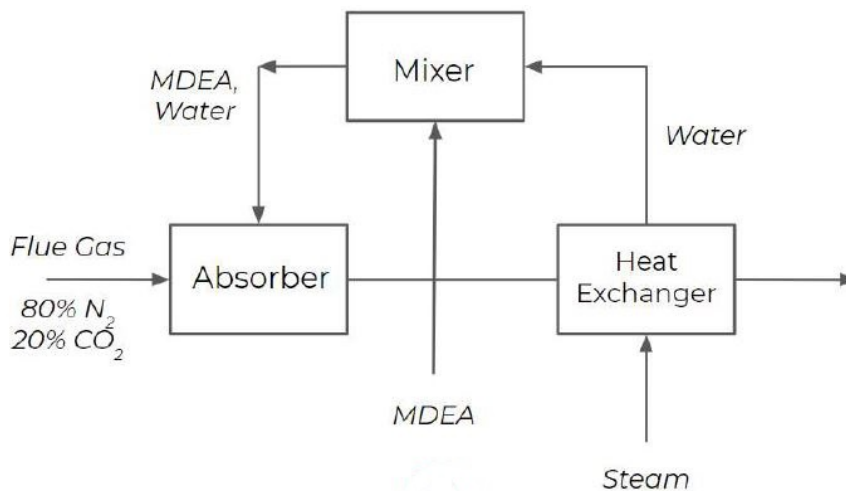


Fig. 1

- b) The hydrostatic pressure test is normally performed on pressure vessels by process operating and maintenance teams. What is the purpose of this test? Outline the procedural steps in performing this test. [7]

c) Outline;

- i. The basic steps,
- ii. the information you need and
- iii. where to find it at each stage in developing a process simulation using

QUESTION 4

a) List **5 (five)** advantages of MATLAB as a tool for solving engineering problems. [5]

b) Explain the use of the following MATLAB commands:

(i) `clc`

(ii) `clear all` [2]

c) Differentiate between a syntax and a programming error. [3]

d) Study the following lines of code and answer the questions that follow:

```
mat = ones (6,6)
for i = 1:6
    for j = 1:6
        p = i + j
        if p > 5
            break
        else
            mat (i,j) = mat (i,j) * 3;
        end
    end
end
end
```

i. What is the value of p after the final 'end' statement? [3]

ii. How many times will the 'break' statement be executed? [3]

iii. How many of the original elements are changed after the final 'end' statement? [4]

QUESTION 5

a) Write a MATLAB code step by step to solve the differential equation and plot the following function on a plot/graph:

Consider an 80 kg paratrooper falling from 600 meters. The trooper is accelerated by gravity, but decelerated by drag on the parachute.

Governing equation:

$$m \frac{d^2 y}{dt^2} = -mg + \frac{4}{15} V^2$$

m = paratrooper mass (kg)

g = acceleration of gravity (m/s²)

V = trooper velocity (m/s)

y = height (m)

initial velocity is assumed to be zero

Comment on your work – marks are awarded for effectiveness of comments.

Present your work neatly – marks are awarded for the clarity and effectiveness of presentation. [10]

b) Write a MATLAB *function* $d = dsc(c)$ that takes a one-dimensional array of numbers c and returns an array d consisting of all the numbers in array c with all

neighbouring duplicated numbers being removed. For example, if $c = [1\ 2\ 2\ 2\ 3\ 1]$, then $d = [1\ 2\ 3\ 1]$.

Comment on your work – marks are awarded for effectiveness of comments.
Present your work neatly – marks are awarded for the clarity and effectiveness of presentation. [10]

END OF EXAMINATION