NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

CHEMICAL ENGINEERING PLANT DESIGN

SCH 4108

Examination Paper

December 2024

This examination paper consists of 3 pages

Time Allowed: **3 hours**
Total Marks: **100**
Special Requirements: **Graph paper**
Examiner's Name: **Dr. B. Nyoni**
External Examiner: **Prof. G. Mehlana**

INSTRUCTIONS

1. Answer all questions in Section A and any other three questions from Section B
2. Each question carries 20 marks
3. Show steps clearly in any calculation
4. Start the answers for each question on a fresh page
5. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	20
2.	20
3.	20
4.	20
5.	20
TOTAL	100

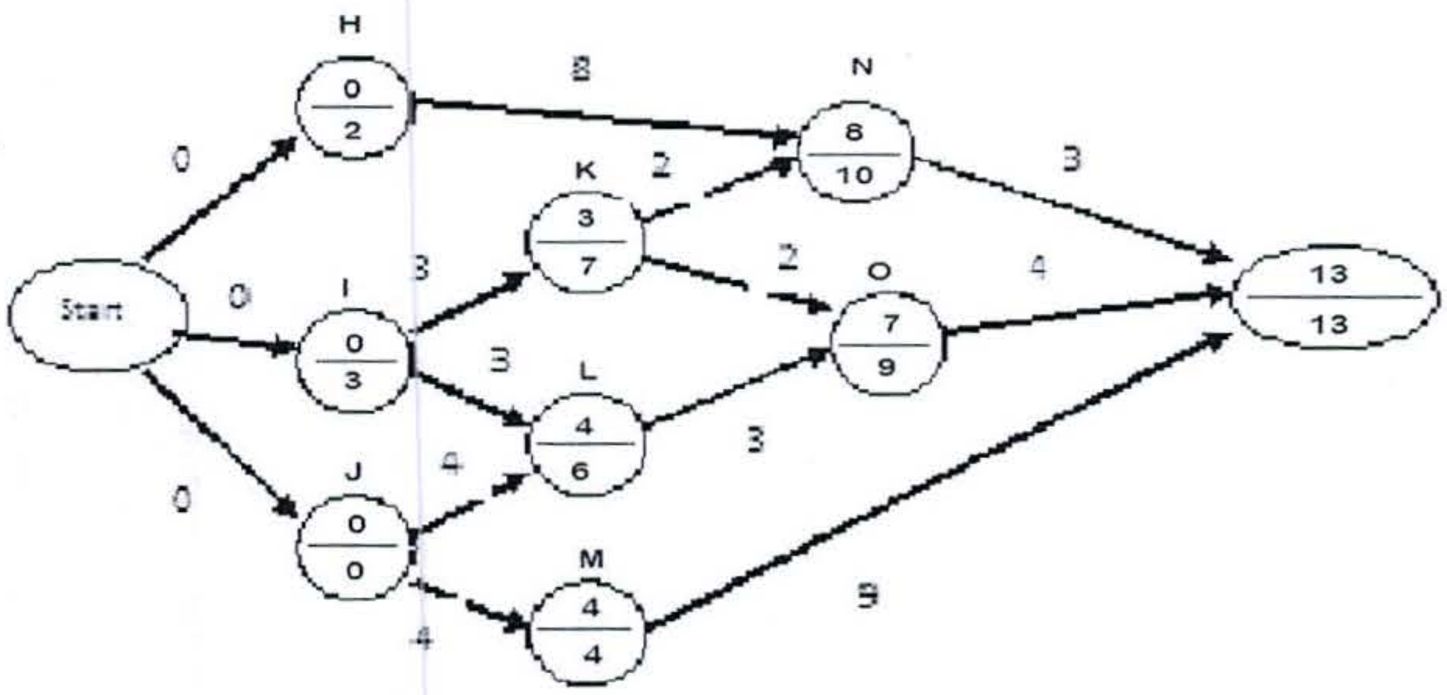
SECTION A

1 (a) What do you understand by the term "plant design"? [4]

(b) With the aid of a diagram, outline the anatomy of a chemical manufacturing process [13]

(c) Why are recycle streams important in a manufacturing process? [3]

2 (a) A project consists of the following activity network in which the vertices represent activities and the numbers next to the arcs represent time in days.



Assuming that an unlimited number of workers is available, write down:

(i) the minimum completion time

(ii) the corresponding critical path [18]

(iii) List any two projects where critical path methods can be applied. [2]

SECTION B

3 (a) Define the following terms

(i) Computer simulation

(ii) Flow-sheeting [8]

(b) List two advantages and disadvantages of computer aided design [4]

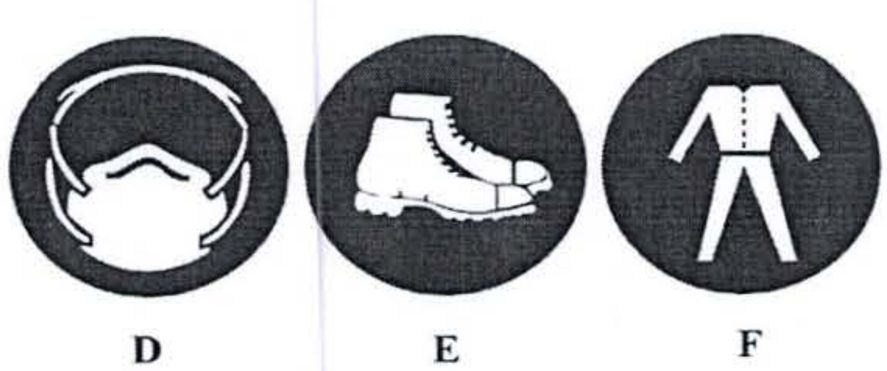
(c) The figure below shows a number of tools that are used by chemical plant operators for their daily plant maintenance routines. Give **names** and **use** of any **four** tools of your choice. [8]

4 (a) What is safety? [3]

(b) (i) What does the abbreviation PPE stand for? [1]

(ii) The figure below shows symbols for PPE in a chemical plant. Write down the names of the PPE labelled A - F. [6]

A B C



D E F

(c) Define the following methods of reducing hazardous events.

(i) HAZOP
(ii) FTA
(iii) FMEA [10]

5 (a) What is a variable? [2]

(b) Explain the term degrees of freedom. [2]

(c) A cylindrical batch reactor is losing liquid reactants through a leak at the bottom. You are asked to find an expression that relates the height of the reactants in the reactor at any time if the reactor has a diameter of 2 m, the hole has a diameter of 1 cm and the initial height of the reactor when the hole was opened was 2.25 m. Also determine when will the reactor be empty? [16]

6 **(a)** Discuss any two factors that affect the investment and production costs. [6]

(b) Explain the difference between fixed and working capital [6]

(c) The purchased cost of a heat exchanger of 450 m^2 area in 1990 was \$25000.

(i) Estimate the cost of the same heat exchanger in 2001 using the two indices given below.

(ii) Comment on the results

	1990	**2001**	
Marshall and Swift Index	915	1094	
Chemical Engineering Plant Cost Index	358	397	[8]

END OF QUESTION PAPER!!!!