



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

CHEMICAL ENGINEERING PLANT DESIGN

SCH 4108

First Semester Examination Paper

December 2016

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements:

Examiner's Name: Dr E Sanganyado

INSTRUCTIONS

1. Answer ALL questions from Section A and Any Three (3) questions from Section B.
2. Start each question on a fresh page.

MARK ALLOCATION

QUESTION	MARKS
SECTION A:	40
SECTION B: 5.	20
6.	20
7.	20
8.	20
TOTAL POSSIBLE MARKS	100

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Section A

Answer all questions.

1. At an AIChE annual meeting, Dr. Sheldon Cooper said, “Engineering standards and codes are not essential when designing a plant.”
 - a. Define engineering standards and codes. [2 marks]
 - b. List 3 examples of engineering standards and codes. [3 marks]
 - c. Do you agree with Dr. Sheldon Cooper? And why? [5 marks]

2. Effective cooperation during plant design depends on effective communications. However, all design organizations have formal procedures for handling project information and documentation. The project documentation will include calculation sheets and drawings.
 - a. What other project documentation are essential in plant design? [2 marks]
 - b. List 3 types of drawings important in project documentation. [3 marks]
 - c. Eng. Nothabo Khumalo forgot to include cost estimates and material balances in her calculation sheets. How will this mistake affect the health, safety, and environmental information? [5 marks]

3. The minister of energy recommended that a biogas plant should be constructed in Chiroti, a small village 100 km from a small town called Karoi. However, engineers from Zimbabwe Electricity Supply Authority believe constructing the biogas plant is possible but not probable. Do you agree with the ZESA engineers and why? [10 marks]

4. The following questions are on site selection. Answer True or false and each question is worth 2 marks.
 - a. The process units and ancillary buildings should be laid out to give the most economical flow of personnel around the site.

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- b. The process units and ancillary buildings should be laid out to give the most economical flow of materials around the site.
- c. Hazardous processes must be located close to other buildings.
- d. Considerations should be given for laboratories for process quality control.
- e. The main storage areas should be placed between the loading and unloading facilities and the process units they serve.

[10 marks]

Section B

Answer only 3 questions.

5. A process for making a single product involves reacting two liquids in a continuously agitated reactor and distilling the resulting mixture. Unused reactants are recovered as overhead and are recycled. The product is obtained in sufficiently pure form as bottoms from the distillation tower.

- a. Prepare a qualitative flow sheet for the process, showing all pieces of equipment. [7 marks]

- b. With cross reference to the qualitative flow sheet, list each piece of equipment and tabulate for each the information needed concerning chemicals and the process in order to design the equipment. [8 marks]

- c. What additional information is required to prepare
 - i. A full process flow diagram [2 marks]
 - ii. A piping and instrumentation diagram [3 marks]

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6. Tapuwa Chimuti has designed a process for drying pumpkin leaves. He wants to sell the dried pumpkin leaves during summer when they are scarce. The pumpkin leaves have to be stored at 5°C.
- a. What is the optimum practical shape for a dwelling, to minimize the heat losses through the building fabric? [2 marks]
 - b. Why is this optimum shape seldom used? [1 marks]
 - c. What people do use the optimum shape for their winter dwellings? [2 marks]
 - d. Is heat retention their only consideration in selection of this shape? What else (if any) should be considered and why? [5 marks]
 - e. Discuss the factors that Tapuwa Chimuti need to consider when constructing the storage unit. [10 marks]
7. A plant is producing 10,000 t/y of a product. The overall yield is 70 per cent, on a mass basis (kg of product per kg raw material). The raw material costs \$10/t, and the product sells for \$35/t. A process modification has been devised that will increase the yield to 75 per cent. The additional investment required is \$35,000, and the additional operating costs are negligible. Is the modification worth making? [20 marks]
8. During the semester you were required to design a wastewater treatment plant for a rural hospital. Discuss the steps you took from project conception up to preliminary plant design. Include the process flow diagrams, problem statement, external and internal constraints, optimization and general site considerations. [20 marks]

END OF QUESTION PAPER!!!!

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