NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL ENGINEERING

MANAGEMENT, ECONOMICS AND OPTIMISATION

TCE 5101

Special Supplementary Examination Paper

July 2024

This examination paper consists of **five** pages

Time Allowed: 3 hours

Special Requirements: None

INSTRUCTIONS

1. Answer **All** questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

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

QUESTION 1

a) What is 'Budgetary Control' and how is it achieved. **[3]**

b) The project life cycle refers to a logical sequence of activities to accomplish the project's goals or objectives. Regardless of the scope or complexity, any project goes through a series of stages 4 stages during its life. Using a suitable diagram describe the FOUR phases. **[8]**

c) On any project, you will have a number of project constraints that are competing for your attention. Give a list of four such constraints. **[5]**

d) Define the word 'Budget' and describe its characteristics. **[5]**

e) Sate the key differences between a fixed and a flexible budget. **[4]**

QUESTION 2

a) You have prepared the following information in the table 2 below for an experiment in which the key resource is a pH meter. The project is contingent on having 3 pH meters available. The chemistry department requests from you in desperation, they are one pH meter short for a teaching practical and would like to borrow one of yours. You tell chemistry department that you'll be willing to loan them one of yours if, and only if, you can complete your experiment in 11 days.

Develop a loading chart and resource schedule in your loading chart **[15]**

Table 2: Experiment in which the key resource is a pH meter

Activity ID	Preceding Activity	Duration	Number of pH Meters Required
1	-	1	1
2	-	2	1
3	-	3	1
4	1,2	2	1
5	2,3	4	2
6	4,5	2	2

b) There exists various methods of network analysis. Examples include the PERT and CPM. What are the key differences between PERT and CPM **[10]**

QUESTION 3

a) A developer is planning to build a new subdivision consisting of townhouses, single-story detached houses and two-story detached houses. On one acre he can put 6 townhouses or 4 single-story houses or 2 two-story houses and he has 60 acres available. It costs him $40,000 to build each townhouse, $50,000 to build each single-story house and $60,000 to build each two-story house. He makes a profit of $15,000 on each townhouse, $18,000 on each single-story house and $20,000 on each two-story house and he has $2,880,000 of capital available. Townhouses require 2500 hours of labour, single-story houses require 3000 hours of labour and two-story houses require 4000 hours of labour and he has 240,000 hours of labour available. How many houses of each type should he construct in order to maximize his profit? Formulate this as a linear programming problem and maximize using the SIMPLEX method. **[15]**

b) Two manufacturers are to produce safety shoes A and B. 'X' safety shoes are to be produced at A and 'Y' are produced at factory B. The cost of production is given by $C(x,y) = 6x^2 + 12y^2$. If 90 safety shoes are to be produced, what is the number that should be produced at each factory?

[10]

QUESTION B4

a) A Bulawayo chemical company must produce 1 000 kg of a special mixture of phosphate and potassium for a customer. Phosphate costs $5/kg and potassium costs $6/kg. No more than 300 kg of phosphate can be used, and at least 150 kg of potassium must be used. Solve the problem such that the company can minimize costs? **[5]**

b) List 5 objectives of budgeting **[5]**

c) A product manager for a soap manufacturer must decide whether or not to offer a new, biodegradable laundry detergent. The projected profit from a successful detergent is $2 million, whereas failure of the product would result in a loss of $1 million. The manager currently thinks there is a 40% chance that the product will be successful. Not offering the product would not change profits. At a cost of $100,000, the product can be tested. Consumer testing can be favourable, a 50% chance, or unfavourable. Given a favourable test result, the chance of product success is judged to be 80%. However, for an unfavourable test result, the chance of product success is judged to be only 30%.

Construct a decision tree for this problem. What is the optimal decision strategy and its expected value?

[15]