UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

YEAR TWO SEMESTER TWO 2022/2023 FINAL ASSESMENT

COURSE UNIT : LINEAR PROGRAMMING

COURSE CODE : MTC 2202

PROGRAM (S) : BACHELOR OF COMPUTER SCIENCE AND BACHELOR OF SCIENCE IN EDUCATION

DATE: Friday 26/05/23

TIME: 2.00 – 5.00 pm

DURATION: 3 hours

Instructions:

1. This examination consists of **EIGHT** questions.
2. Attempt any **FIVE** questions. Each question caries 20 marks.
3. Do not write anything on the questions paper.
4. Carefully read through ALL the questions before attempting.
5. No **names** should be written anywhere on the examination booklet.
6. Ensure your work is **clear** and **readable**. Untidy work shall be penalized.
7. Any type of examination Malpractice will lead to automatic disqualification.
8. Ensure that your **Registration number** is indicated on all pages of the examination answer booklet.
9. Remember to indicate the question numbers you have attempted.

QUESTION ONE

(a) Write short notes on each of the following terms using relevant examples.

(i) Linear programing **[2 marks]**

(ii) Decision variables **[2 marks]**

(iii) Objective function **[2 marks]**

(iv) Constraints **[2 marks]**

(b) Write the general form of a linear programming problem. **[2 marks]**

(c) Give any **three** advantages of mathematical optimization models? **[6 marks]**

(d) Explain any **two** applications of linear programming models in real life. **[4 marks]**

QUESTION TWO

(a) Explain the steps followed while solving a linear programming problem using primal simplex method. **[6 marks]**

(b) Give one advantage of primal simplex method over graphical method. **[1 mark]**

(c) (i) Solve the following linear programming problem using primal simplex method.

$$Max\ Z = -7x_1 + 9x_2 + 3x_3$$

Subject to

$$5x_1 - 4x_2 - x_3 \leq 10$$
$$x_1 - x_2 \leq 4$$
$$-3x_1 + 4x_2 + x_3 \leq 1$$
$$x_1, x_2, x_3 \geq 0$$

[10 marks]

(ii) Find the optimal solution to the linear programming problem. **[3 marks]**

QUESTION THREE

(a) Explain the steps followed while solving a linear programming problem using graphical method. **[6 marks]**

(b) Give one advantage and one limitation of solving linear programming problems using graphical method. **[2 marks]**

(c) An electronic company manufactures two radio models each on a separate production line. The daily capacity of the first line is 60 radios and that of the second line is 75 radios. Each unit of the first model uses 10 pieces of a certain electronic component, whereas each unit of the second model uses 8 pieces of the same component. The maximum daily availability of the special component is 800 pieces. The profit per unit of models 1 and 2 are Shs. 5000 and Shs. 4000 respectively. Determine the optimal daily production of each model. **[12 marks]**

QUESTION FOUR

(a) State the entry and exit criteria for the dual simplex method. **[4 marks]**

(b) Given the following simplex tableau;

		3	4	5	0	0	
CB_j	x_B	x_1	x_2	x_3	S_1	S_2	$\bar{x}_B$
4	x_2	1/2	1	0	1/2	−1/2	6
5	x_3	0	0	1	−1/4	1	3
$z_j - c_j$							

(i) What variables form the basis? **[2 mark]**

(ii) What are the current values of the decision variables? **[2 marks]**

(iii) Determine the optimal solution using the given tableau. **[6 marks]**

(iv) Supposing the coefficient of x_2 is changed from 4 to 8. What is the new solution corresponding to this change? **[6 marks]**

QUESTION FIVE

(a) Give the major reasons why the simplex method is efficient in the solution of linear programming problems. **[4 marks]**

(b) The following are four special cases that can occur during the application of the simplex method in solving linear programming problems; alternative optima, degeneracy, unbounded solutions and infeasible solutions. Write short notes on each case using relevant examples. **[16 marks]**

QUESTION SIX

(a) What is meant by standard form of a linear programming problem? **[1 mark]**

(b) Distinguish between canonical maximization and canonical minimization of a linear programing problem and write the general form for each. **[6 marks]**

(c) Write the following minimization linear programing problem in canonical minimization form. **[5 marks]**

$Minimize Z = x_1 + 4x_2 - x_4$

Subject to:

$2x_1 + x_2 + 2x_3 - 2x_4 \geq 4$

$x_1 - 3x_2 + x_4 \leq 5$

$x_1 + 2x_2 + 3x_3 \geq 3$

$x_1, x_2, x_3, x_4 \geq 0$

(d) Convert them to canonical maximization linear programming problem. **[4 marks]**

(e) Transform them into standard form. **[4 marks]**

QUESTION SEVEN

(a) Explain the steps followed while solving a linear programming problem using dual simplex method. **[6 marks]**

(b) Find the optimal solution to the following linear programming problem using the dual simplex algorithm. **[14 marks]**

$\min w = 2x_1 + 3x_2 + 3x_3$

Subject to

$2x_1 - 3x_2 + x_3 \geq 4$

$x_1 + x_2 + 2x_3 \geq 3$

$x_1, x_2, x_3 \geq 0$

QUESTION EIGHT

A farmer produces among other feeds tree different types of chicken feed. The chicken feed is made out of three main ingredients; corn, lime and fish meal. Each of these ingredients contain three nutrients; proteins, calcium and vitamins. The following table gives the different nutrient contents of one unit of measure of each ingredient for every type of feed.

Nutrients	Feed type 1	Feed type 2	Feed type 3
Proteins	4	2	2
Calcium	2	1	2
Vitamins	2	3	3

The total proteins, calcium and vitamins contained in the ingredients should not exceed 210, 110 and 135 units of measure respectively. Let the net profit on one unit of feed1, type 2 and type 3 be 6, 4 and 6 monetary units respectively.

(a) Formulate the linear programming model of determining how much of each type of feed the farmer should produce to maximize profit. **[6 marks]**

(b) Determine the optimal solution for the farmer. **[mark]**

GOOD LUCK