JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY SCHOOL OF AGRICULTURAL AND FOOD SCIENCES

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE IN AGRIBUSINESS MANAGEMENT,

SECOND YEAR SECOND SEMESTER 2024/2025 ACADEMIC YEAR

SIAYA CAMPUS

COURSE CODE: AEB 1301

COURSE TITLE: Operations Research

EXAM VENUE: **STREAM: BSc (Agribusiness Management)**

DATE: **EXAM SESSION:**

TIME: 2.00 Hours

Instructions:

1. **Answer ALL questions in Section A (compulsory) and ANY other TWO questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

Section A (30 Marks)

(Answer all six questions. Each question carries 5 marks.)

1. Explain Operations Research (OR) and its importance in business decision-making. [5 Marks]
2. Describe the key steps involved in formulating an Operations Research model. [5 Marks]
3. illustrate the significance of the objective function, constraints, and non-negativity restrictions for a Linear Programming Problem (LPP) with two decision variables. [5 Marks]
4. Given the following system of equations:
   $x_1 + 2x_2 + x_3 = 1$
   $2x_1 + 4x_2 + x_3 = 3$, Identify whether a basic feasible solution exists and justify your answer. [5 Marks]
5. What are shadow prices in sensitivity analysis, and how do they influence decision-making in Linear Programming? [5 Marks]
6. Describe the Simplex Algorithm and explain its significance in solving optimization problems. [5 Marks]

Section B (40 Marks)

(Answer any TWO questions. Each question carries 20 marks and has two parts.)

7. A small manufacturer makes two products A and B. Two resources, R1 and R2 are required to make these two products. Each unit of product A requires 1 unit of R1 and 3 units of R2. Each unit of product B requires 1 unit of R1 and 2 units of R2. The manufacturer has 5 units of R1 and 12 units of R2 available. The manufacturer makes a profits pf KES 6 per unit of product A sold and KES 5 per unit of product B sold.

   Let X_1= Number of units of product B made and X_2 = Number of units of product B made.
   a. Formulate a mathematical model for the manufacturer's situation that can be used to maximise profit. [5 Marks]
   b. Graphically find the optimal solution to the manufacturer's problem. . [15 Marks]

8. Farmer Jane owns 45 acres of land. She is going to plant each with wheat or corn. Each acre planted with wheat yields 200 Kenya shillings profit; each with corn yields 300 Kenya shillings profit. The labour and fertilizer used for each acre of wheat are 3 workers and 2 tons respectively. The labour and fertilizer used for each acre of corn are 2 workers and 4 tons respectively. One hundred workers and 120 tons of fertilizer are available. Use linear programming to determine the optimum level at which Jane can maximize profits from her land. Let X1 = the number of acres of corn planted, and X2 = the number of acres of wheat planted.

a. Formulate a mathematical model of farmer Jane's situation that can be used to maximize profit. [5 Marks]
b. Use the simplex algorithm to solve the Jane's problem. [15 Marks]

9.

a. Differentiate between basic and non-basic variables in Linear Programming. Provide an example for each. [10 Marks]
b. Demonstrate the process of determining the entering and departing variables in the Simplex Algorithm. [10 Marks]