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

SECOND YEAR SECOND SEMESTER UNIVERSITY RESIT EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE IN AGRIBUSINESS MANAGEMENT,

2022/2023 ACADEMIC YEAR

REGULAR

COURSE CODE: BBM 3226

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]

1. Define the following terms as used in linear programming
    a. Linear programming problem [3 Marks]:
    b. Feasible region [3 Marks]
    c. The optimal solution in a maximization problem [3 Marks]
    d. The optimal solution in a minimization problem [3 marks]
    e. Sensitivity analysis. [3 Marks]
2. Why don't we allow a linear programme to have < or > constraints? [3 Marks]
3. Give two importance of sensitivity analysis [4 Marks]
4. Study the maximization problem given below and answer the questions about Problem.

Max $Z = 30X_1 + 100X_2$

Subject to

$X_1 + X_2 \leq 7$	**[Land constraint]**
$4X_1 + 10X_2 \leq 40$	**[Labour constraint]**
$10X_1 \geq 30$	**[Government constraint]**
$X_1, X_2 \geq 0$	**[sign restriction]**

    a. Is (X_1 = 2, X_2 = 3) in the feasible region? Explain. [2 Marks]
    b. Is (X_1 = 4, X_2 = 3) in the feasible region? Explain. [2 Marks]
    c. Is (X_1 = 2, X_2 = -1) in the feasible region? Explain. [2 Marks]
    d. Is (X_1 = 3, X_2 = 2) in the feasible region? Explain. [2 Marks]

SECTION B [40 MARKS]

5. 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 X_1 = number of acres of corn planted, and X_2 = 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 farmer Jane's problem. [15 Marks]

6. Twiga Agrochemical Company manufactures herbicides and insecticides. Each chemical must be processed in the mixing shop and packaging shop. If the mixing shop were only mixing insecticides, then 40 litres per day could be mixed. If the mixing shop were only mixing herbicides, then 60 litres per day could be mixed. If the packaging shop were only producing herbicides, then it could process 50 litres per day. If the packaging shop were only producing insecticides, then it could process 50 litres per day. Each insecticide contributes $300 to profit, and each herbicide contributes $200 to profit. Use linear programming to determine a daily production schedule that will maximize the company's profits. X_1 = litres of insecticide produced daily X_2 = litres of a herbicide produced daily.

a. Convert the Twiga Agrochemical Company problem to a standard form. [5 Marks]

b. Graphically find all optimal solutions to the above LP. [15 Marks]

7.

a. Dorian Auto manufactures luxury cars and trucks. The company believes that its most likely customers are high-income women and men. To reach these groups, Dorian Auto has embarked on an ambitious TV advertising campaign and has decided to purchase 1-minute commercial spots on two types of programs: comedy shows and football games. Each comedy commercial is seen by 7 million high-income women and 2 million high-income men. Each football commercial is seen by 2 million high-income women and 12 million high-income men. A 1-minute comedy ad costs $50,000, and a 1-minute football ad costs $100,000. Dorian would like the commercials to be seen by at least 28 million high-income women and 24 million high-income men. Use linear programming to determine how Dorian Auto can meet its advertising requirements at a minimum cost. Let x1 = number of 1-minute comedy ads purchased, x2 = number of 1-minute football ads purchased. Find the optimal solution graphically [5 Marks]

b. Use the simplex algorithm to find the optimal solution to the following LP. [15 Marks]

$$\textbf{Min } Z = 4X_1 - X_2$$

Subject to

$$2X_1 + X_2 \leq 8$$

$$X_2 \leq 5$$

$$X_1 - X_2 \leq 4$$

$$X_1, X_2 \geq 0$$