(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION AND BACHELOR OF SCIENCE

COURSE CODE: **MAT 430**

COURSE TITLE: **OPERATION RESEARCH III**

DATE: 7/10/2021 **TIME:** 2:00 PM - 4:00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION 1 (30 Marks)

a) i) State three concepts of goal programming [3mks]
ii) State two ways of goal programming model formulation [2mks]

b) Find the optimum value of the objective function when subject to the following constraints.

$$\textbf{Maximize } Z = 10x_1 - x_1^2 + 10x_2 - x_2^2$$

$$\textbf{Subject to the constraints}$$

$$x_1 + x_2 \leq 14$$

$$-x_1 + x_2 \leq 6$$

$$x_1, x_2 \geq 0$$

[5mks]

c) A packaging company packs two types of products Q and R. The unit profit from product Q is Shs 100 and that of product R is Shs 50. The goal of the company is to earn a total profit of exactly Shs 700 in the next week. Formulate this problem as a Goal programming problem. [4mks]

d) Solve the following nonlinear programming using lagrangean method.

$$\textbf{Minimize } Z = 2x_1^2 - 3x_2^2 + 18x_2$$

Subject to $2x_1 + x_2 = 8$

$$x_1 \textbf{ and } x_2 \geq 0$$

[6mks]

e) Use the method of Multipliers to solve the following Non-linear programming problem.

$$\textbf{Optimize } Z = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$$

$$\textbf{Subject to the constraint}$$

$$g(x) = x_1 + x_2 + x_3 = 20$$

$$\textbf{and } x_1,\ x_2,\ x_3 \geq 0$$

Does the solution maximize or minimize the objective function?

[10mks]

QUESTION 2 (20 Marks)

a) Determine x_1 and x_2 so as to

$$\textbf{Maximize } Z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$$

$$\textbf{Subject to the constraints}$$

$$x_1 \leq 8$$

$$x_1 + x_2 \leq 10$$

$$\textbf{and } x_1, x_2 \geq 0$$

[6mks]

b) Use modified simplex method to solve the following Goal Programming problem.

$$\boldsymbol{Minimize\ Z = P_1 d_1^- + P_2 d_4^- + (2P_3 d_2^- + P_3 d_3^-) + P_4 d_1^+}$$

Subject to

$$\boldsymbol{x_1 + x_2 + d_1^- + d_1^+ = 10}$$
$$\boldsymbol{x_1 + d_2^- = 6}$$
$$\boldsymbol{x_2 + d_3^- = 8}$$
$$\boldsymbol{d_1^+ + d_4^- - d_4^+ = 2}$$

Where

$$\boldsymbol{x_1,\ x_2,\ d_1^-,\ d_1^+,\ d_2^-,\ d_3^-,\ d_4^- \geq 0}$$

[14mks]

QUESTION 3 (20 Marks)

a) Give the condition of Maxima and Minima in lagrangian multipliers [2mks]

b) Obtain necessary condition for the optimum solution of the following problem

$$\boldsymbol{Minimize\ f(x_1, x_2) = 3e^{2x_1+1} + 2e^{x_2+5}}$$

Subject to the constraint

$$\boldsymbol{g(x_1, x_2) = x_1 + x_2 - 7 = 0}$$

[8mks]

c) Solve the following nonlinear programming problem using lagrangian method:

$$\boldsymbol{Maximize\ Z = x_1^2 + 2x_2^2 + x_3^2}$$
$$\boldsymbol{Subject\ to\ 2x_1 + x_2 + 2x_3 = 30}$$
$$\boldsymbol{x_1\ and\ x_2 \geq 0}$$

[10mks]

QUESTION 4 (20 Marks)

a) Use Wolfe's Method to solve the quadratic programming problem

$$\boldsymbol{Maximize\ Z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2}$$

Subject to the constraint

$$\boldsymbol{x_1 + 4x_2 \leq 4}$$

$$\boldsymbol{and\ x_1, x_2 \geq 0}$$

[16mks]

b) Solve the following nonlinear programming problem using Kuhn-Tucker conditions.

$$\boldsymbol{Maximize\ Z = 3x_1^2 + 14x_1x_2 - 8x_2^2}$$

$$\boldsymbol{Subject\ to\ 3x_1 + 6x_2 \leq 72}$$

$$\boldsymbol{x_1\ and\ x_2 \geq 0}$$

[4mks]

QUESTION 5 (20 Marks)

Use Beal's Method to solve the following quadratic programming problem

$$\boldsymbol{Maximize\ Z = 2x_1 + 3x_2 - 2x_2^2}$$

Subject to the constraints

$$\boldsymbol{x_1 + 4x_2 \leq 4}$$

$$\boldsymbol{x_1 + x_2 \leq 2}$$

$$\boldsymbol{and\ x_1, x_2 \geq 0}$$