



(Knowledge for Development)

**KIBABII UNIVERSITY**  
**UNIVERSITY EXAMINATIONS**  
**2021/2022 ACADEMIC YEAR**  
**FOURTH YEAR SECOND SEMESTER**  
**SPECIAL/ SUPPLEMENTARY EXAMINATION**  
**FOR THE DEGREE OF BACHELOR OF SCIENCE**

**COURSE CODE: MAA 425**

**COURSE TITLE: OPERATION RESEARCH III**

**DATE: 24/11/2022**

**TIME: 8:00 AM - 10:00 AM**

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**INSTRUCTIONS TO CANDIDATES**

**Answer Question One and Any other TWO Questions**

*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.

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

*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.

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

$$\text{Subject to } 2x_1 + x_2 = 8$$

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

[6mks]

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

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

*Subject to the constraint*

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

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

Does the solution maximize or minimize the objective function?[10mks]

**QUESTION 2: (20 Marks)**

- a) Determine  $x_1$  and  $x_2$  so as to

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

*Subject to the constraints*

$$x_1 \leq 8$$

$$x_1 + x_2 \leq 10$$

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

[6mks]



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

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

Subject to

$$x_1 + x_2 + d_1^- + d_1^+ = 10$$

$$x_1 + d_2^- = 6$$

$$x_2 + d_3^- = 8$$

$$d_1^+ + d_4^- - d_4^+ = 2$$

Where

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

[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

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

Subject to the constraint

$$g(x_1, x_2) = x_1 + x_2 - 7 = 0$$

[8mks]

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

$$\text{Maximize } Z = x_1^2 + 2x_2^2 + x_3^2$$

$$\text{Subject to } 2x_1 + x_2 + 2x_3 = 30$$

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

[10mks]

**QUESTION 4: (20 Marks)**

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

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

Subject to the constraint

$$x_1 + 4x_2 \leq 4$$

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

[16mks]

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

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

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

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

[4mks]

**QUESTION 5: (20 Marks)**

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

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

Subject to the constraints

$$x_1 + 4x_2 \leq 4$$

$$x_1 + x_2 \leq 2$$

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