(Knowledge for Development)

# KIBABII UNIVERSITY

## UNIVERSITY EXAMINATIONS

## 2019/2020 ACADEMIC YEAR

## FOURTH YEAR FIRST SEMESTER

## SPECIAL/ SUPPLEMENTARY EXAMINATION

## FOR THE DEGREE OF BACHELOR OF SCIENCE MATHEMATICS

**COURSE CODE:** **MAT 430**

**COURSE TITLE:** OPERATION RESEARCH III

**DATE:** 12/02/21 **TIME:** 8 AM -10 AM

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**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 (2mk)

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

Maximize $Z = 3x_1^2 + 14x_1x_2 - 8x_2^2$

Subject to

$3x_1 + 6x_2 \leq 72$

$x_1$ and $x_2 \geq 0$

(5mks)

c) Solve the following nonlinear programming using lagrangean method.

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

Subject to

$\boldsymbol{2x_1 + x_2 = 8}$

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

(7mks)

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

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

Subject to the constraint

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

(7mks)

e) Solve the following nonlinear programming problem using lagrangean method:

Maximize $Z = x_1^2 + 2x_2^2 + x_3^2$

Subject to $2x_1 + x_2 + 2x_3 = 30$

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

(6mks)

**QUESTION 2: (20 Marks)**

a) Use the method of Multipliers to solve the following Non-linear programming problem.
Optimize $Z = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$

Subject to the constraint
$g(x) = x_1 + x_2 + x_3 = 20$
and $x_1,\ x_2,\ x_3 \geq 0$
Does the solution maximize or minimize the objective function? (9mks)

b) Use Beal's Method to solve the following quadratic programming problem
Maximize $Z = 2x_1 + 3x_2 - 2x_2^2$

Subject to the constraints
$x_1 + 4x_2 \leq 4$
$x_1 + x_2 \leq 2$
and $x_1, x_2 \geq 0$

(11mks)

**QUESTION 3: (20 Marks)**

a) Find the optimum value of the objective function when subject to the following constraints.
$\boldsymbol{Maximize\ Z = 10x_1 - x_1^2 + 10x_2 - x_2^2}$

***Subject to the constraints***
$x_1 + x_2 \leq 14$
$-x_1 + x_2 \leq 6$
$x_1, x_2 \geq 0$

(7mks)

b) Use Wolfe's Method to solve the quadratic programming problem
Maximize $Z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$

Subject to the constraint
$\boldsymbol{x_1 + 4x_2 \leq 4}$
$\boldsymbol{and\quad x_1, x_2 \geq 0}$

(13mks)

**QUESTION 4: (20 Marks)**

a) Give the condition of Maxima and Minima in lagrangean multipliers. (4mks)

b) Determine $x_1$ and $x_2$ so as to

Maximize $Z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$

***Subject to the constraints***

$x_1 \leq 8$

$x_1 + x_2 \leq 10$

$\boldsymbol{and\ x_1, x_2 \geq 0}$ (8mks)

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

Maximize $Z = x_1^2 + 2x_2^2 + x_3^2$

Subject to $2x_1 + x_2 + 2x_3 = 30$

$\boldsymbol{x_1\ and\ x_2 \geq 0}$ (8mks)

**QUESTION 5: (20 Marks)**

a) A packaging company packs two types of products Q and R. The unit profit from product Q is Ksh 100 and that of product R is Ksh 50. The goal of the company is to earn a total profit of exactly Ksh 700 in the next week. Formulate this problem as a Goal programming problem. (5mks)

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

$\boldsymbol{Minimize\ Z = P_1d_1^- + P_2d_4^- + (2P_3d_2^- + P_3d_3^-) + P_4d_1^+}$

Subject to the constraints

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

Where

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

(15mks)