



(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER

SPECIAL/SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: MAT 430

COURSE TITLE: OPERATIONS RESEARCH III

DATE: 20/01/2022

TIME: 11:00 - 1:00 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 (2mk)

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

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

Subject to

$$3x_1 + 6x_2 \leq 72$$

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

(5mks)

- c) Solve the following nonlinear programming using lagrangean method.

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

Subject to

$$2x_1 + x_2 = 8$$

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

(7mks)

- d) 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

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

(7mks)

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

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

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

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

(6mks)

QUESTION 2: (20 Marks)

- a) 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? (9mks)

- b) 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

$$x_1 + 4x_2 \leq 4$$

$$x_1 + x_2 \leq 2$$

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

(11mks)

QUESTION 3: (20 Marks)

- a) 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

$$x_1 + x_2 \leq 14$$

$$-x_1 + x_2 \leq 6$$

$$x_1, x_2 \geq 0$$

(7mks)

- b) 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

$$x_1 + 4x_2 \leq 4$$

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

(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

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

Subject to the constraints

$$x_1 \leq 8$$

$$x_1 + x_2 \leq 10$$

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

(8mks)

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

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

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

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

(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.

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

Subject to the constraints

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

$$x_1 + d_2^- = 6$$

$$x_2 + d_3^- = 8$$

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

Where

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

(15mks)