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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE (APPLIED STATISTICS WITH COMPUTING)

COURSE CODE: STA 214

COURSE TITLE: OPERATION RESEACH I

DATE: 15/03/2021 **TIME:** 1400 – 1700 HRS

INSTRUCTION TO CANDIDATES

- SEE INSIDE

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REGULAR – MAIN EXAM

STA 214: OPERATION RESEARCH I

STREAM: ASC **DURATION: 3 Hours**

INSTRUCTION TO CANDIDATES

Answer **ALL** questions from section A and **ANY THREE** Questions in section B.
All questions in section B carry Equal Marks

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SECTION A (31 marks): Answer ALL questions.

QUESTION ONE (16MKS)

a) Define the following terms as applied in operation research.

i) Linear Model. [1Mark]

ii) Linear Programming. [2 Marks]

iii) inequality [1Mark]

iv) Feasible Solution. [2Mark]

b) List and explain three elements of optimization in linear programming. [3Marks]

c) Explain four areas where assignment problem is applicable. [4Marks]

d) List three uses of the dual simplex; [3Marks]

QUESTION TWO (15 Marks)

a) List five assumption of linear programming. [5Marks]

b) Use simplex method to find the maximum value of

$z = 2x_1 - x_2 + 2x_3$ Objective function

Subject to the constraints

$$2x_1 + x_2 \leq 10$$

$$x_1 + 2x_2 - 2x_3 \leq 20$$

$$x_2 + 2x_3 \leq 5$$

Where $x_1 \geq 0, x_2 \geq 0 \; and \; x_3 \geq 0$ [5Marks]

c) State the steps for the simplex method in operation research. [5Marks]

SECTION B (39 MARKS, CHOOSE ANY THREE QUESTIONS)

QUESTION THREE (13 MARKS)

a) A transport company has two types of trucks, Type A and Type B. Type A has a refrigerated capacity of $20m$ and a non-refrigerated capacity of $40m^3$ while Type B has the same overall volume with equal sections for refrigerated and non-refrigerated stock. A grocer needs to hire trucks for the transport of $3,000m^3$ of refrigerated stock and $4,000m$ of non-refrigerated stock. The cost per kilometer of a Type A is $30, and $40 for Type B.

i) Choose the unknowns. [1Mark]

ii) Write the objective function. [1Mark]

iii) Write the constraints as a system of inequalities. [3Marks]

iv) Find the set of feasible solutions that graphically represent the constraints. [2Marks]

b) Calculate the coordinates of the vertices from the compound of feasible solutions. [3Marks]

c) How many trucks of each type should the grocer rent to achieve the minimum total cost? [3Marks]

QUESTION FOUR (13 Marks)

a) The KICOMI retail store stocks two types of shirts A and B, These are packed in attractive cardboard boxes. In one week the store can sell a maximum of 400 shirts of type A and a maximum of 300 shirts of type B. The storage capacity, however, is limited to a maximum of 600 of both types combined. Type A shirt fetches a profit of Kshs. 20/- per unit and type B a profit of Kshs. 50/- per unit. The store wants to establish how many of each type of shirt they need to stock per week in order to maximize their total profit. Formulate a mathematical model for this problem. [8Marks]

b) Let C be a nonempty subset of R^n, and let $\lambda 1$ and $\lambda 2$ be positive scalars. Show that if C is convex, then $(\lambda_1 + \lambda_2)C = (\lambda_1 C + \lambda_2 C)$. Show by example that this need not be true when C is not convex. [5Marks]

QUESTION FIVE (13 Marks)

Use the simplex method to solve the (LP) model: [13Marks]

$$Max\ Z = 5x_1 + 4x_2$$

Subject to:

$$6x_1 + 4x_2 \leq 24$$
$$x_1 + 2x_2 \leq 24$$
$$-x_1 + x_2 \leq 1$$
$$x_2 \leq 2$$
$$x_{1,}x_2 \geq 0$$

QUESTION SIX (13 Marks)

Kenya power has three electric power plants that supply the electric needs of four cities. The associated supply of each plant and demand of each city is given in the table below. The cost of sending 1 million kwh of electricity from a plant to a city depends on the distance the electricity must travel.

From	Destination				Supply
	City 1	city 2	city 3	city 4	(Million kwh)
Plant 1	\$8	\$6	\$10	\$9	30
Plant 2	\$9	\$12	\$13	\$7	50
Plant 3	\$14	\$9	\$16	\$5	40
Demand (Million kwh)	45	20	30	30	

Calculate the basic feasible solution for a balanced transport using;

a) Formulate a transportation model that satisfy both supply and demand. [5Marks]

b) Northwest Corner Method [4Marks]

c) Minimum Cost Method [4Marks]

QUESTION SEVEN (13 Marks)

Solve, if possible, the linear programming problem by using dual simplex method. [13Marks]

$$Min\ Z = x_1 + 5x_2$$

Subject to:

$$3x_1 + 4x_2 \leq 6$$
$$x_1 + 3x_2 \geq 3$$

$$x_1 x_2 \geq 0$$

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