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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATION, 2022/2023 ACADEMIC YEAR
SECOND YEAR, SECOND SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF BUSINESS
INFORMATION TECHNOLOGY

Date: 19th April, 2022
Time: 8.30am –10.30am

KMA 2214 - OPERATION RESEARCH METHODS

INSTRUCTIONS TO CANDIDATES

ANSWER **QUESTION ONE (COMPULSORY)** AND **ANY OTHER TWO** QUESTIONS

QUESTION ONE (30 MARKS)

a) State and explain areas where operations research can be applied to aid in decision-making.
(5 marks)

b) i) What is linear programming?
(2 marks)

ii) Give the advantages of linear programming.
(5 marks)

c) Suppose an industry is manufacturing two types of products P1 and P2. The profits per Kg of the two products are Ksh.30 and Ksh.40 respectively. These two products require processing in three types of machines. The following table shows the available machine hours per day and the time required on each machine to produce one Kg of P1 and P2. Formulate the problem in the form of linear programming model

Profit/kg	P1 Ksh. 30	P2 Ksh. 40	Total available machine hours/day
Machine 1	3	2	600
Machine 2	3	5	800
Machine 3	5	6	1100

(6 marks)

d) The AXY company has the following transportation problem

	DESTINATION			SUPPLY
SOURCE	R	S	T	
A	1	2	3	100
B	4	1	5	110
DEMAND	80	120	60	210 / 260

Where the transport cost from A to R is 1, B to S is 1, etc. Obtain an initial feasible solution using the northwest corner rule.

(6 marks)

e) Solve the following linear program Using graphical method

Maximize z = 5x + 3y

subject to

$x + 2y \leq 14$

$3x - y \geq 0$

$x - y \leq 2$

(6 marks)

QUESTION TWO (20 MARKS)

a) What are the requirements of linear programming? (5 marks)

b) Consider the following LP problem:

Minimize $2X_1 + 3X_2$

Subject to the constraints $X_i \geq 0$, i = 1, 2, and

$X_1 + 2X_2 \geq 4$

$X_1 + X_2 \geq 3$.

i) Convert this problem to a maximization problem.

(4 marks)

ii) Solve the problem of (a) by the graphical method

(11 marks)

QUESTION THREE (20 MARKS)

a) Use the simplex method to solve the problem

Max Z = $X_1 + 2X_3$
Subject to
$X_1 + 2X_2 + X_3 \leq 2$
$X_3 \leq 1$
$X_1 \geq 0, X_2 \geq 0, X_3 \geq 0.$
At each stage say which variables are entering and exiting basic variables. (15 marks)

b) Consider the problem

Max Z = $5X_1 + 7X_2$
Subject to
$X_1 + 2X_2 \leq 4$
$X_1 + X_2 \leq 3$
$X_1 \geq 0, X_2 \geq 0.$
Find the dual to this LP. (5 marks)

QUESTION FOUR (20 MARKS)

a) A company manufactures two types of computer, type A and type B. Manufacturing a type A computer requires 4 hours of labour and 2 computer chips. Each type B computer requires 2 hours of labour and 1 computer chip. There are 800 hours of labour and 700 chips available per month. The company is able to sell up to 100 type A computers and up to 400 type B computers per month. For each type A computer sold the company makes a profit of £150, while the profit on each type B computer is £50. The company's aim is to maximize monthly profits. Formulate this problem as a linear program.

Sketch the feasible region of the problem, and find the optimal solution. Which, if any, of the constraints are redundant and which are binding at optimality?

(14 marks)

b) Sketch the feasible region for the linear program
Maximize Z=$X_1 + 2X_2$

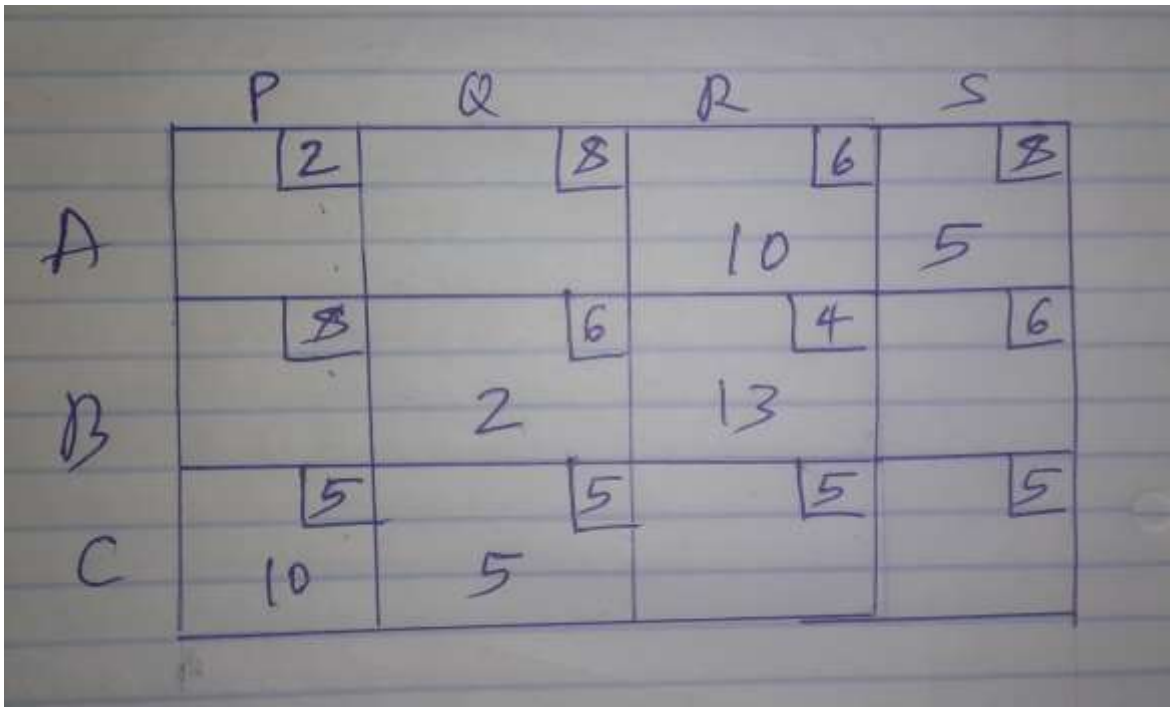
Subject to
$3X_1 + 2X_2 \leq 6$
$2X_1 + 3X_2 \leq 6$
$X_1, X_2 \geq 0$

Use your sketch to solve this problem graphically, i.e. find the optimal solution.

(6 marks)

QUESTION FIVE (20 MARKS)

a) Solve the following Transportation Problem starting from the initial basic feasible solution given



(12 marks)

b) Three orchards supply crates of oranges to four retailers. The daily demands from retailers 1, 2, 3 and 4 are 150, 150, 400 and 100 crates respectively. Supply at the orchards is dictated by available labour, the daily supply available from orchards A, B, C being 300, 300 and 200 crates respectively. The transportation costs (£) per crate from the orchards to the retailers are given in the table below.

ORCHARD		RETAILER			
		1	2	3	4
ORCHARD	A	1	2	3	2.5
	B	2	4	2.8	2.7
	C	1.5	3	5	3

Formulate this problem as a transportation problem in tableau form and give an initial feasible solution using the Least-Cost method. (4 marks)

Suppose now that the demand from retailer 1 increases to 250 crates per day. It is possible for

Orchard A to supply more crates by using overtime labour, at an additional cost of £1.50 per crate; orchards B and C do not offer this option. Explain how the formulation of the original problem may be modified for this new situation, writing down an appropriate modified tableau.

(4 marks)