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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATION, 2023/2024 ACADEMIC YEAR
THIRD YEAR, SECOND SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

Date: 8th December, 2023
Time: 2.30 –4.30pm

KMA 2313 - OPERATIONS RESEARCH

INSTRUCTIONS TO CANDIDATES

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

QUESTION ONE (30 MARKS)

a) Explain 'Operations Research' and why it is important to study it. (2 marks)

b) Operations research is applied in a wide range of areas to ensure the smooth running of businesses and other institutions. Using clear examples, illustrate five areas of application of operations research. (5 marks)

c) The Mwihoko retail store stocks two types of shirts A and B. 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 shirts 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 should be stocked per week in order to maximize the total profit. Identify the decision variables and constraints for this problem. (4 marks)

d) The Linear Programming problem is formulated to determine the optimum solution by selecting the best alternative from the set of feasible alternatives available to the decision-maker. Briefly explain three assumptions that underlie linear programming models. (3 marks)

e) The primal problem is given as

$$Maximize \quad Z = 45x_1 + 80x_2$$

subject to

$$5x_1 + 20x_2 \leq 400$$
$$10x_1 + 15x_2 \leq 450$$
$$x_1, x_2 \geq 0$$

Determine

i) The dual problem (3 marks)

ii) The optimum solution for (i) above using the graphical method. (5 marks)

f) A manufacturing company produces two products, A and B, at the production levels x1 and x2 respectively. The profit per product is such that, KES 2 for A and KES 5 for B. The production constraints are $x_1 + 3x_2 \leq 40,\ 3x_1 + x_2 \leq 24,\ x_1 + x_2 \leq 10$. The company cannot produce less than zero amount of either or both products.

i) Formulate a standard LP model for this problem (3 marks)

ii) Using the graphical method, find the maximum profit (5 marks)

QUESTION TWO (20 MARKS)

a) Differentiate between dual and primal problem as used in linear programming. (2 marks)

b) Simplex method applies mathematical and logical calculations to determine the solution to a linear programming problem. Briefly explain the simplex algorithm process. (5 marks)

c) Consider the following LPP

$$Maximize\ Z = 3x_1 + 2x_2$$

$$\begin{aligned} Subject\ to \quad & -x_1 + 2x_2 \leq 4 \\ & 3x_1 + 2x_2 \leq 14 \\ & x_1 - x_2 \leq 3 \\ & x_1, x_2 \geq 0 \end{aligned}$$

Using the simplex method, determine

i) The standard form including slack variables (3 marks)

ii) First iteration (3 marks)

iii) The maximum value of Z and values of x_1 and x_2 that give this Z (7 marks)

QUESTION THREE (20 MARKS)

a) Regional planning deals with the efficient placement of land use activities, infrastructure, and settlement growth across a larger area of land. Explain

i) Three types of regional planning and give examples for each. (6 marks)

ii) Four principles that guide regional planning. (4 marks)

b) A farmer has 20 hectares for growing barley and swedes. The farmer has to decide how much of each to grow. The cost per hectare for barley is KES 30 and for swedes is KES 20. The farmer has a budget of KES 480.

Barley requires 1 man-day per hectare and swedes require 2 man-days per hectare. There are 36 man-days available.

The profit on barley is KES 100 per hectare and on swedes is KES 120 per hectare.

i) Formulate an LPP model for this information (4 marks)

ii) Find the number of hectares of each crop the farmer should sow to maximize profits. (6 marks)

QUESTION FOUR (20 MARKS)

a) Rational management resource allocation in any organization ensures that resources are utilized effectively. Giving examples, discuss three principles that guide resource allocation in an institution. (6 marks)

b) Planning enhances proper allocation of resources, good relations between the employer and employees and progressive growth of the institution. Discuss four barriers to effective planning. (4 marks)

c) Consider the bicriterion problem

$Maximize: \{Z_1, Z_2\}$

Subject to: $x + y \geq 2$

$x + 3y \leq 9$

$3x + y \leq 9$

$x, y \geq 0$

i) Draw the graph of the feasible region for this problem. (4 marks)

ii) If $Z_1 = x + 5y$ and $Z_2 = 7x + y$, state the values of x, y, Z_1, Z_2 at each vertex of the feasible region. Identify the non-inferior solutions. (6 marks)

QUESTION FIVE (20 MARKS)

a) Describe three agricultural-economic development models and give examples of specific applications. (6 marks)

b) Suppose a manufacturing company owns three factories (sources) and distributes its products to five different retail agencies (destinations). The following table shows the capacities of the three factories, the quantity of products required by the various retail agencies, and the cost of shipping one unit of the product from each of the three factories to each of the five retail agencies.

	Retail Agency					
Factories	1	2	3	4	5	Capacity
1	1	9	13	36	51	50
2	24	12	16	20	1	100
3	14	33	1	23	26	150
Requirement	100	60	50	50	40	

i) Formulate a linear programming model for this problem (5 marks)

Determine the basic feasible solution using;

ii) North West Corner method (5 marks)

iii) Least cost method (4 marks)