MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2022/ 2023 ACADEMIC YEAR
THIRD YEAR FIRST SEMESTER

SCHOOL OF BUSINESS AND ECONOMICS.
DEGREE IN ECONOMICS AND STATISTICS AND PUBLIC PLANNING.

COURSE CODE: ECO 3107

COURSE TITLE: OPERATIONS RESEARCH.

DATE: DECEMBER, 2022 **TIME:**

INSTRUCTIONS TO CANDIDATES

Answer Question ONE and any other TWO questions

This paper consists of FOUR printed pages. Please turn over.

QUESTION ONE

a. Define linear programming **(2 marks)**

b. Give three characteristics of the transportation problem **(3 marks)**

c. Explain what is meant by optimality condition and feasibility condition **(4 marks)**

d. Find an initial feasible solution for the following model **(3 marks)**

$Max: Z = 7X1 + 10X2$

Subject to:

$5X1 + 4X2 \leq 24$

$2X2 + 5X2 \leq 13$

$X1, X2 \geq 0$

e. An assembly line consisting of three consecutive stations produces two radio models namely HiFi-1 and HiFi-2. The following table provides the assembly times for the three work stations.

Workstation	Minutes per unit	
	HiFi-1	HiFi-2
1	6	4
2	5	5
3	4	6

The daily maintenance for stations 1,2 and 3 consumes 10%, 14% and 12%, respectively, of the maximum 480 minutes available for each station each day. Formulate a linear programming model that will minimize the idle (unused) times in the three workstations **(4 marks)**

f. Construct the arrow diagram comprising activities A, B,…, O, so that the following relationships are fulfilled. **(4 marks)**

1. A and B (the first activities of this project) can start simultaneously.
2. A precede D,C.
3. B precede C,E,F.
4. C and E precede G and I.
5. D and G precede H.
6. F, I precede K and L.
7. K, L precede M and N
8. L precede H
9. H,M precede O
10. O and N are the terminal activities of the project

QUESTION TWO

a. In a departmental store one cashier is there to serve the customers. And the customers pick up their need by themselves. The arrival rate is 8 customers for every 4 minutes and the cashier can serve 10 customers in 4 minutes. Assuming Poisson arrival rate and exponential distribution for service rate, find:
   i. Average number of customers in the system **(2 marks)**
   ii. Average queue length **(2 marks)**
   iii. Average time a customer spend in the queue **(2 marks)**
   iv. Average time a customer spend in the system **(2 marks)**

b. Give any three applications of network models **(3 marks)**

c. Consider eight equal squares arranged in three rows, with two squares in the first row, four in the second and two in the third. The squares of each row are arranged symmetrically about vertical axis. Fill the squares with distinct numbers in the range 1 to 8 so that no two adjacent verticals, horizontal or diagonal squares hold consecutive numbers. Use a network presentation to find the solution in a systematic way **(4 marks)**

QUESTION THREE

a. Kericho tea company produces tea for local use, internal market and external/export from three tea plant species, T1, T2and T3, as provided in the following table.

Tea plant	Tons of tea			Maximum daily available tons
	Local use	Internal use	External use	
T1	1	2	1	430
T2	3	0	2	460
T3	1	4	0	420
Profit per ton (Ksh.1000)	3	2	5	

Kericho tea company wants to determine the optimum (best) product mix for local, internal and external market that maximizes the daily profit. Find an optimal solution to this problem using the simplex technique. **(15 marks)**

QUESTION FOUR

a. A national truck rental firm, Westland trucking company, is planning for a heavy demand of rental trucks during the month of December. An inventory of its trucks combined with projections for demand indicates that three metropolitan areas will be short of the number of trucks required to satisfy expected demand. Three other metropolitan areas have surpluses of trucks above the number expected to be needed during this period. In an effort to prepare for the period of heavy demand, company officials wish to relocate trucks from those metropolitan areas expected to have surpluses to those having shortages. Drivers can be hired to drive the trucks between cities, and the company would like to redistribute its trucks at a minimum cost. The costs in dollars of driving a truck between cities as well as the surplus and shortage values of each metropolitan area is provided in the following data. Find a solution using

Origin (surplus area)	Destination (shortage area)			Supply (surplus of trucks)
	1	2	3	
1	50	100	100	110
2	200	300	200	160
3	100	200	300	150
Demand (shortage)	140	200	80	**420**

i. Northwest corner method **(4 marks)**

ii. The Least Minimum Cost method **(4 marks)**

iii. Vogels method **(7 marks)**

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