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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY UNIVERSITY EXAMINATIONS, 2024/2025 ACADEMIC YEAR FIRST YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS <u>KMA 2402 OPERATIONS RESEARCH II</u>

Date: 14TH AUGUST 2024 Time: 11:30AM – 1:30 PM

<u>INSTRUCTIONS TO CANDIDATES</u> <u>ANSWER QUESTION ONE (COMPULSORY)</u> AND ANY OTHER TWO QUESTIONS

QUESTION ONE: COMPULSORY (30 MARKS)

a) Six towns are located as shown in the network below. The values given in the edge represent the distance (in miles) between the towns.



Akinyi who is a professional athlete is planning a marathon from town A to F. The marathon has no specific route; thus, she is figuring out the possible route to follow so that she minimizes the distance to cover. Find the route she should use so as to attain her objective. (5 Marks)

b) Consider the project with the following activities

Task:	А	В	С	D	E	F	G	Н	Ι	J	K
Predecessor(s)			А		B, C	D	D	E, F	E, F	I, G	Η
Optimistic time:	4	5	8	2	4	6	8	5	3	5	6
Most likely time:	5	7	11	3	7	9	12	6	5	8	9
Pessimistic time:	8	10	12	7	10	15	16	9	7	11	13

i. For each activity, compute the;

i) Expected Time.

ii) Variance.

ii. Draw the network.

(3 Marks) (3 Marks)

(3 Marks) (3 Marks)

Origin	D	Supply		
Origin	Α	В	С	Suppry
1	2	7	4	5
2	3	3	1	8
3	5	4	7	7
4	1	6	2	14
Demand	7	9	18	34

c) Consider the transport network given in the table below

Set up the initial basic feasible solution using;

i) Least Cost Method.

ii) North West Corner Rule.

d) A transport company has 5 carriers located in different pints is planning on transportation of some goods to 5 different places. The time taken by the carriers from where it is located to the destinations are as shown below.

Location	Destination							
Location	Ι	II	III	IV	V			
А	20	15	18	20	25			
В	18	20	12	14	15			
С	21	23	25	27	25			
D	17	18	21	23	20			
Е	18	18	16	19	20			

How can Transport Company assign the transportation of goods among the carriers so as to minimize total transport time? (5 Marks)

- e) Suppose that through your research, you determine that your most popular product, a vanilla-scented candle, has holding cost of KES 100 per unit, ordering cost of KES 65,000 per order and the annual demand is 10, 000 units. Compute the Economic order quantity and the number of orders required per year. (3 Marks) (3 Marks)
- f) Explain **THREE** characteristics of dynamic models.

QUESTION TWO: (20 MARKS)

The following is list of activities for a certain project.

Activity	А	В	С	D	E	F	G	Η	Ι	J	K
Predecessor		Ι		А	В	В	С	F, G	E	D	I, J
Duration (days)	2	2	1	4	5	8	3	5	4	1	3

- a) Draw the network diagram for the project.
- b) Use a table to determine the following times for each node;
 - i) Earliest start time.
 - ii) Earliest Finish Time.
 - iii) Latest finish time.
 - iv) Latest start time.
 - v) Float time.
- c) Obtain the critical path for the project, and the minimum time required to complete (3 Marks) the project.

(3 Marks) (2 Marks)

- (5 Marks)
- (3 Marks)
- (2 Marks) (3 Marks)
- (2 Marks)
- (2 Marks)

QUESTION THREE: (20 MARKS)

A fortunate seeker was to travel from stage A to stage j by stagecoach passenger. Due to the risk expected, the stagecoach passenger company changes life assurance policy on their passengers. Since the cost of the policy was based on careful evaluation of the safety run, the safest route should be the one with the cheapest total life insurance policy. The total cost for standard policy from i to j denoted by C_{ij} is



- a) Draw a sketch diagram for the problem.
- b) Determine the route that minimizes the total cost of the policy.
- c) Graphically display the dynamic programming solution.

QUESTION FOUR: (20 MARKS)

a) Consider the transportation problem given below

S		G l			
Source	D1	D2	D3	D4	Supply
01	3	1	7	4	300
02	2	6	5	9	400
03	8	3	3	2	500
Demand	250	350	400	200	1200

i) Set up the initial solution using the North-West corner rule.

ii) Is the solution above feasible or infeasible? Why?

- iii) Obtain the optimal solution.
- b) A Company has four men available for work on four separate jobs. Only one man can work on any one job. The cost of assigning each man to each job is given in table below.

Job	Ι	II	III	IV
А	20	25	22	28
В	15	18	23	17
С	19	17	21	24
D	25	23	24	24

Assign men to jobs in such a way that the total cost of assignment is minimum.

(4 Marks) (10 Marks) (6 Marks)

(2 Marks)

- (2 Marks)
- (11 Marks)

QUESTION FIVE: (20 MARKS)

a) Consider the undirected network of roads where the weights are in miles given in the diagram below



Apply Dijkstra's algorithm to find the shortest rout from node A to node H. (8 Marks)

- b) Let the annual demand, cost per unit, cost per order, and annual holding cost per unit be D, C, O and H respectively. Derive the economic order quantity Q. (4 Marks)
- c) ABC Ltd. uses EOQ logic to determine the order quantity for its various components and is planning its orders. The Annual consumption is 80,000 units, Cost to place one order is KSH. 8,300, Cost per unit is KES. 350 and carrying cost is 6% of Unit cost. The company works for 300 days in a year and the lead time is 5 days. Find EOQ,

	$\cdots \cdots $
i) Economic Order Quantity.	(2 Marks)
ii) The number of cycles.	(2 Marks)
iii)Reorder level.	(2 Marks)
iv) Total annual cost of inventory.	(2 Marks)