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University Examinations 2023/2024

THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY AND BACHEOR OF BUSINESS INFORMATION TECHNOLOGY

SMC 3255: OPERATIONS RESEARCH

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) Define operations research and give a brief historical development of operation research (5 marks)

b) Define Linear programming and give three assumptions of linear programming (6 marks)

c) A manufacturing company owns three factories (A,B&C) and distribute his products to five different retail agencies (1,2,3,4&5). The following table shows the capacities of the three factories, the quantity of product 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. Find the initial feasible solution of the transportation problem below using North West Corner Rule (5 marks)

	1	2	3	4	5	Capacity
A	1	9	17	36	51	50
B	12	24	18	20	1	100
C	15	33	1	23	26	150
Requirement	100	60	50	50	40	

d) A manufacturer uses ksh.20,000 worth of an item during the year. Manufacturer estimated the ordering cost as ksh.50 per order and holding costs as 12.5% of average inventory value. Find the optimal order size (EOQ) and total cost of the inventory (6 marks)

e) The following are the time estimates and the precedence relationships of the activities in a project network

Activity	Predecessor activity	Duration (weeks)
A	-	2
B	A	9
C	A	5
D	B	10
E	C	5
F	D,E	7

i. Draw the network diagram (2 marks)

ii. Determine the critical path (2 marks)

f) Define Queuing theory and give 2 elements of queue system (2 marks)

QUESTION TWO (20 MARKS)

a) The arrival rate of customers at a banking counter follows a Poisson distribution with a mean for 30 customers per hour. The service rate of the counter clerk also follows Poisson distribution with mean of 45 customers per hour. Calculate

i. The average time the clerk is idle (2 marks)

ii. The number of customers waiting in the bank (2 marks)

iii. The number of customers waiting in the queue (2 marks)

iv. The average waiting time in the queue (2 marks)

b) A farm contains four persons available for work on the four jobs. Only one person can work on any one job. The following table shows the cost of assigning each person to each job. Hungarian method to determine the cost of the assignment (8 marks)

	Job 1	Job 2	Job 3	Job 4
Person 1	20	25	22	28
Person 2	14	18	23	17
Person 3	19	16	21	24
Person 4	25	23	23	25

c) Give four differences between CPM and PERT (4 marks)

QUESTION THREE (20 MARKS)

a) The estimates of time in weeks of the activities of a project are given in the table below. Determine the critical path and project completion time (11 marks)

Activity	Predecessor activity	T_0	t_m	t_p
A	-	2	4	6
B	A	8	11	20
C	A	10	15	20
D	B	12	18	24

E	C	8	13	24
F	C	4	7	16
G	D,F	14	18	28
H	E	10	12	14
I	G,H	7	10	19

b) Three machine shops A,B,C produces three types of products 1,2,3 respectively. Each product involves operation of each of the machine shops. The time required for each operation on various products is given as follows

	A	B	C	Profit per unit
1	10	7	6	12
2	2	3	7	3
3	1	2	11	10
Available hours	30	77	80	

i. Formulate the linear programming problem that will maximize profit (5 marks)

ii. Write the dual of the LPP above (4 marks)

QUESTION FOUR (20 MARKS)

a) A production unit uses ksh.10,000 worth of an item during the year. The production units estimated the ordering cost as ksh. 25 order and holding cost as 12.5 percent of the average inventory value. Determine

i. The optimal order size (4 marks)

ii. The number of orders per year (2 marks)

iii. Time period per order (2 marks)

b) A furniture company owns three warehouses in the Meru town and needs to deliver chairs to its three shops in Maua town. Delivery costs from each warehouse to each store are different due to different distances. These are as follows (in $ per unit) find the minimum cost

	Shop 1	Shop 2	Shop 3	Supply
Warehouse 1	7	3	4	80
Warehouse 2	4	3	2	60
Warehouse 3	2	1	5	30
Demand	40	50	80	

Of transportation using VAM method (8 marks)

c) Give two differences between a transportation problem and assignment problem (4 marks)

QUESTION FIVE (20 MARKS)

a) A food processing company makes two types of products, product 1 and product 2. Product 1 is sold at ksh.300 and product 2 is sold at ksh. 400. These 2 products requires three types of raw material. A,B and C. the table below lists the availability of the raw materials and the profits

	A	B	C	Profit
Product 1	2	1	1	300
Product 2	1	3	0	250
Requirements	40	45	12	

i. Formulate the above as a linear programming problem (5 marks)

ii. Solve the above LPP using Simplex method (15 marks)