KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : MATH 304
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 01 AUG 2024

SECTION "A"

[10 Q. × 0.5 = 5 marks]

Fill in the blank space(s) by most appropriate words or symbol(s):

1. If the i^{th} constraint of the primal problem is of $=$ type, then the variable y_i in the dual problem will be _____.

2. If the value of d_{ij} in an unoccupied cell of the optimal solution of transportation problem is zero, then there are _____.

3. A transportation problem having m number of rows and n number of columns is called degenerate if the number of allocated cells are_____.

4. Modified Distribution Method is used to test the optimality in the _____ _____.

5. Maximization in assignment problem can be converted into the minimization problem by subtracting all the elements from the _____ including itself.

6. A travelling salesman can visit _____ number of cities in $(n-2)!$ different ways.

7. As the complexity of a model increases, simulation seeks to replicate the _____ in the model.

8. The service time in an $M/M/1$ queueing model is characterized by _____.

9. Customer behavior in which the customer moves from one the queue to another in a multiple channel situation is called_____.

10. Network is the graphical display of a project that contains both activities and _____.

SECTION "B"

[10 Q. × 0.5 = 5 marks]

Fill in the blank space(s), ***DO NOT TICK,*** *by selecting the most appropriate answers from among the given ones.*

11. If any value in X_B column of the final simplex table is negative then the solution is _____.

[basic; feasible; infeasible; optimal]

12. In an Integer Linear Programming Problem non integer variable is taken to _____.

[obtain the cut constraint; enter the solution;
leave the solution; increase the solution values]

13. In an all Integer Linear Programming Problem _____.

[some variables could be non-integer;
right hand side of the constraints should be integer;
all the decision variable co-efficient should be integer;
all the solution variables should be integer]

14. The degeneracy in the transportation problem indicates that _____ _____.

[there are multiple optimal solutions; the problem has no feasible solution;
the problem is unbalanced; feasible solution has been obtained]

15. Which of the methods is commonly used to solve assignment problem? _____.

[North – West corner rule; Vogel's approximation method;
Least cost method; Hungarian method]

16. If an assignment problem is not an optimal, there is a rule to mark certain rows and columns. After the suitable marking in the rows and columns, we should draw the lines in the rows and columns. These lines should be drawn for _____ _____.

[marked rows and marked columns; unmarked rows and unmarked columns;
marked rows and unmarked columns; unmarked rows and marked columns]

17. The result of simulation should be considered as an_____ value.

[exact; simplified; approximate; fixed]

18. If 30 customers arrive at a store per hour and each customer spends about 20 minutes in there, then the number of customers at all time on average is_____.

[8; 10; 12; 15]

19. In $M / M / 1$ queueing model if the traffic intensity $\rho = 0.8$, then the value of L_q is _____.

[3.0; 3.1; 3.2; 3.3]

20. The expected time of an activity is calculated by _____.

[$t_e = \frac{t_0+4t_m+t_p}{6}$; $t_e = \frac{t_0+4t_m-t_p}{6}$; $t_e = \frac{t_0-4t_m+t_p}{6}$; $t_e = \frac{t_0-4t_m-t_p}{6}$]

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01 AUG 2024

Course : MATH 304
Semester : I
F. M. : 50

SECTION "C"
[3 Q. × 7 = 21 marks]

1. Solve the following Linear Programming Problem (LPP): [7]

Maximize $Z = x_1 - x_2 + 3x_3$
Subject to the constraints
(i) $x_1 + x_2 + x_3 \leq 10$, (ii) $2x_1 - x_3 \leq 2$,
(iii) $2x_1 - 2x_2 + 3x_3 \leq 0$, $x_1, x_2, x_3 \geq 0$

OR

A company produces three products: P, Q and R from three raw materials A, B and C. One unit of product P requires 2 units of A and 3 units of B. A unit of product Q requires 2 units of B and 5 units of C and one unit of product R requires 3 units of A, 2 units of B and 4 units of C. The company has 8 units of material A, 10 units of material B and 15 units of material C available to it. Profits per unit of products P, Q and R are Rs. 3, Rs. 5 and Rs. 4, respectively.

a. Formulate this problem as an LP problem. [2]
b. How many units of each product should be produced to maximize the profit? [5]

2. An established company has decided to add a new product to its line. It will buy the product from a manufacturing concern, package it, and sell it to a number of distributors that have been selected on a geographical basis. Market research has already indicated the volume expected and the size of sales force required. The steps shown in the following table are to be planned.

Activity	Description	Predecessors	Duration (Days)
A	Organize sales office	--	6
B	Hire salesmen	A	4
C	Train salesmen	B	7
D	Select advertising agency	A	2
E	Plan advertising campaign	D	4
F	Conduct advertising campaign	E	10
G	Design package	--	2
H	Setup packaging facilities	G	10
I	Package initial stocks	J, H	6
J	Order stock from manufacturer	--	13
K	Select distributors	A	9
L	Sell to distributors	C, K	3
M	Ship stocks to distributors	I, L	5

a. Draw an arrow diagram for this project. [4]
b. Indicate the critical path. [3]

P.T.O.

3. A manufacturer wants to ship 22 loads of his product as shown below. The matrix gives the kilometers from sources (S_i) of supply to the destinations (D_j). [7]

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	5	8	6	6	3	8
S_2	4	7	7	6	5	5
S_3	8	4	6	6	4	9
Demand	4	4	5	4	8	

The shipping cost is Rs 10 per load per km. What shipping schedule should be used in order to minimize the total transportation cost?

SECTION "D"

[5 Q. × 5 = 25 marks]

4. Consider a problem of assigning four clerks to four tasks. The time (hours) required to complete the task is given below:

		Tasks			
		A	B	C	D
Clerks	1	4	7	5	6
	2	--	8	7	4
	3	3	--	5	3
	4	6	6	4	2

Clerk 2 cannot be assigned task A and clerk 3 cannot be assigned task B. Find all the optimum assignment schedules. [5]

5. The optimal solution table for the Linear programming problem

Maximize $Z = x_1 + x_2$

Subject to the constraints

(i) $3x_1 + 2x_2 \leq 5$ (ii) $x_2 \leq 2$, $x_1, x_2 \geq 0$ is

		cj	1	1	0	0
Basic Variables	C_B	$b = x_B$	x_1	x_2	s_1	s_1
x_1	1	1/3	1	0	1/3	-2/3
x_2	1	2	0	1	0	1
		$c_j - z_j$	0	0	-1/3	-1/3

If x_1 and x_2 are both integers. Find the optimum solution for the integer programming problem using Gomory's cutting plane method. [5]

6. Use graphical method to solve the following LP problem. [5]

Maximize $Z = 2x_1 + x_2$
Subject to the constraints
(i) $x_1 + 2x_2 \leq 10$ (ii) $x_1 + x_2 \leq 6$
(iii) $x_1 - x_2 \leq 2$ (iv) $x_1 - 2x_2 \leq 1$ $x_1, x_2 \geq 0$

7. A TV repairman finds that the time spent on his jobs has an exponential distribution with a mean of 30 minutes. If he repairs the sets in the order in which they came in, and if the arrival of sets follows a Poisson distribution with an approximate average rate of 10 per 8-hour day, what is the repairman's expected idle time each day? Also, calculate the average number of TV sets waiting to be repaired in the system. [2.5+2.5]

OR

The new-account officer at a Bank enrolls all new customers in checking accounts. During the 3-week period in Shrawan encompassing the beginning of the new school year, the bank opens a lot of new accounts for students. The bank estimates that the arrival rate during this period will be Poisson distributed with an average of 4 customers per hour. The service time is exponentially distributed with an average of 12 minutes per customer to set up a new account. The bank wants to determine the operating characteristics for this system to determine if the current person is sufficient to handle the traffic. Calculate all the performance measures and suggest the needful recommendations. [5]

8. What do understand by simulation? A bakery keeps stock of a popular brand of cake. Previous experience shows the daily demand pattern for the item with associated probabilities, as given below: [5]

Daily Demand (Number)	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

Use the following sequence of random numbers to simulate the demand for next 10 days.
Random numbers: 25, 39, 65, 76, 12, 05, 73, 89, 19, 49.
Also, estimate the daily average demand for the cakes on the basis of the simulated data.

SECTION "E"

[2 Q. × 2 = 4 marks]

9. Write a short note on the types of queueing discipline.
10. Write the condition(s) to have multiple optimal solutions in an assignment problem.