

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
December, 2024

Marks Scored:

Level : B.Sc.

Year : III

Exam Roll No. :

Time: 30 mins.

Registration No.:

Course : MATH 304

Semester : I

F. M. : 10

Date : 24 DEC 2024

SECTION "A"

[10 Q.  $\times$  0.5 = 5 marks]

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

1. If any value in  $X_B$  column of the final simplex table is negative then the solution is \_\_\_\_\_.
2. The maximum amount we could pay if we want to add one unit of resource is called \_\_\_\_\_.
3. In integer programming, a new cut constraint is added to the existing set of constraints, then in comparison to the resulting new feasible region, the old region is \_\_\_\_\_.
4. In the transportation problem the opportunity cost ( $d_{ij}$ ) is calculated for all unoccupied cells using the formula \_\_\_\_\_.
5. Degeneracy in transportation problem exists if the number of allocations in the transportation table with  $m$  rows and  $n$  columns is \_\_\_\_\_.
6. If salesman has to visit  $n$  number of cities, in how many ways he/she can make tour plan? \_\_\_\_\_.
7. 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 \_\_\_\_\_.
8. \_\_\_\_\_ method is developed through the use of the probability distribution and random numbers.
9. For the stable  $M/M/1$  queueing system the value of  $\rho = \frac{\lambda}{\mu}$  should be \_\_\_\_\_.
10. In the PERT network analysis if  $t_e, t_p, t_o$  and  $t_m$  have their usual meaning what is the formula for  $t_e$ ? \_\_\_\_\_

## SECTION "B"

[10 Q.  $\times$  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. The variable added to the constraint of equal to (=) type in the linear programming problem is called \_\_\_\_\_.  
[slack variable; artificial variable; surplus variable; basic variable]
12. If there are multiple optimal solutions in a linear programming problem then \_\_\_\_\_ value of non-basic decision variables is zero in the optimal solution mix.  
[ $c_j - z_j$ ;  $X_B$ ;  $c_j$ ;  $z_j$ ]
13. The optimum solution of a Linear Programming Problem with all the constraints of  $\leq$  type exist at  $x_1 = 10$ ,  $s_2 = 20$  and  $x_3 = 25$ . What does  $s_2 = 20$  indicate?  
[lack of 20 units of resource 2; 20 units of resource 2 are misused; overuse of 20 units of resource 2; 20 units of resource 2 is still available]
14. A non – integer variable is chosen in the optimal table of the Integer Linear Programming Problem to \_\_\_\_\_.  
[leave the basis; enter the basis; construct a Gomory cut, increase the solution values]
15. Optimality of a transportation problem exists whenever all the value of  $d_{ij}$  are \_\_\_\_\_.  
[positive; negative; zero in some cell; any real number]
16. Maximization in \_\_\_\_\_ can be converted into the minimization problem by subtracting all the elements from the largest element including itself.  
[transportation problem; assignment problem; u-v method; MODI method]
17. In Monte – Carlo simulation random number interval is to be considered based on \_\_\_\_\_.  
[the random numbers; probability; cumulative probability; frequency]
18. In the Kendall's notation  $a/b/c : d/e/f$ , what does  $c$  denote? \_\_\_\_\_.  
[service time distribution; inter – arrival time; traffic intensity; number of servers]
19. In a  $M/M/1$  queueing system, if  $\mu = 22$  and  $\lambda = 20$ , then the probability of being no customers in the system is equal to \_\_\_\_\_.  
[0; 1;  $\frac{10}{11}$ ;  $\frac{1}{11}$ ]
20. Network models have advantage in terms of project \_\_\_\_\_.  
[Planning; Scheduling; Controlling; All of the above]



5. The optimal solution table for the Linear programming problem

$$\text{Maximize } Z = x_1 + x_2$$

Subject to the constraints

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

	$c_j$		1	1	0	0
Basic Variables	$C_B$	$b = x_B$	$x_1$	$x_2$	$s_1$	$s_2$
$x_1$	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.

6. Five Typists A, B, C, D, E are assigned Five jobs to type. Their payments for each jobs are listed in the following table. Each typist is given only one job. Find the least cost allocation to each of the typists. [5]

	P	Q	R	S	T
A	85	75	65	125	75
B	90	78	66	132	78
C	75	66	57	114	69
D	80	72	60	120	72
E	76	64	56	112	68

OR

In the modification of a plant layout of a factory four new machines  $M_1, M_2, M_3$  and  $M_4$  are to be installed in a machine shop. There are five vacant places A, B, C, D and E available. Because of limited space, machine  $M_2$  cannot be placed at C and  $M_3$  cannot be placed at A. The cost of locating a machine at a place (in hundred rupees) is as follows.

		Location				
		A	B	C	D	E
Machine	$M_1$	9	11	15	10	11
	$M_2$	12	9	--	10	9
	$M_3$	--	11	14	11	7
	$M_4$	14	8	12	7	8

Find the optimal assignment schedule.

7. 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:

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 based on the simulated data. [5]

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8. A project consists of the following jobs whose precedence relationship is given below:

Job	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration (Days)	15	15	3	5	8	12	1	14	3	14

- a. Draw the network diagram to represent the above information. [2]  
b. Calculate the critical path and the total project duration. [3]

SECTION "E"

[2 Q.  $\times$  2 = 4 marks]

9. Write short note on degeneracy of a transportation problem.
10. Write the condition for a Linear Programming Problem to be infeasible.

