KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.Sc.
Year : III

Course : COMP 317
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 28 JUL 2024

SECTION "A"
[10 Q. × 0.5 = 5 marks]

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

1. Objective function of the dual of the primal LP problem $Maximize Z = 2x_1 + 5x_2$ subject to constraints $8x_1 + 9x_2 \geq 15; 10x_1 + 18x_2 \leq 20, x_1, x_2 \geq 0$ is _____

2. A necessary and sufficient condition for the existence of a feasible solution to the transportation problem is _____

3. To perform _____ test, we use Modified Distribution Method (MODI) or u-v method.

4. We can generate n^{th} random number by using the formula $r_n = p.\ r_{n-1}\ (modulo\ m)$ where $p, m \in z^+$ and r_0 is called _____

5. An assignment problem is a special case of the _____ _____ problem in operations research.

6. If the assignment problem is unbalanced, dummy _____ _____ are added to balance the matrix.

7. The row in the solution table of integer programing problem corresponding to which we write Gomory's constrain is known as _____

8. Simulation analysis is not _____ technique

9. A car driver waits in petrol pump for while then leave the line without filling the petrol is called _____

10. In duality of LP problem the number of constraints = _____

SECTION "B"
[10 Q. × 0.5 = 5 marks]

Fill in the blank spaces (Question number 11 through 20) by choosing the most appropriate answers from the given MCQs. **DO NOT TICK** the answers.

11. In linear programming, the objective function is _____
[Always to be minimized the objective functions
Always to be maximized the objective functions
Optimize the objective functions
Neither maximized nor minimized the objective functions]

12. Values of the slack variables in the optimal solution represents the _____ at the end of the production.

[Amount of resources have not been used
Amount of resources by which amount objective function increases
Amount of resources remains shortage
Amount of resources by which objective function reduces]

13. What is a mixed-integer programming (MIP) problem? _____

_____

[A problem with only integer variables.
A problem with only continuous variables.
A problem with both integer and continuous variables.
A problem with only binary variables.]

14. In a transportation problem, the main objective is to _____

_____

[Minimize the cost of transportation from several sources to several destinations.
Maximize the profit of transportation from several sources to several destinations.
Equalize the supply and demand at all sources and destinations.
Distribute products equally among all destinations.]

15. In the Hungarian method, what is the first step? _____

_____

[Subtract the smallest element of each row from all elements of that row
Subtract the smallest element of each column from all elements of that column
Assign tasks to minimize cost
Check for an optimal assignment]

16. In the assignment problem, if the number of tasks and the number of agents are not equal, the problem is called _____

[Balanced assignment problem Degenerate assignment problem
Non-degenerate assignment problem Unbalanced assignment problem]

17. The inter arrival time of the customer in the queuing system follow_____

[Poisson distribution Exponential distribution
Binomial distribution Deterministic]

18. In a basic M/M/1 queue, what does the second 'M' represent?

_____

[Memoryless service time distribution Markovian arrival process
Multiple servers Maximum queue length]

19. When solving the assignment problem, what does a zero in the cost matrix typically indicate?

_____

[The task is not available The agent is not available
The assignment has zero cost There is a penalty associated with the assignment]

20. PERT (Program Evaluation and Review Technique) is best suited for which type of projects?

[Routine and repetitive projects
Short-term projects
Projects with a high degree of uncertainty
Projects with fixed timelines]

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SECTION "C"
[3 Q. × 7 = 21 marks]

1. Find the optimal solution of the following linear programing problem by using Dual Simplex method:

$$Minimize\ Z = 3x_1 + 2x_2 + x_3 + 4x_4$$

Subject to the constraints

$$2x_1 + 4x_2 + 5x_3 + 4x_4 \geq 10$$
$$3x_1 - x_2 + 7x_3 - 2x_4 \geq 2$$
$$5x_1 + 2x_2 + x_3 + 6x_4 \geq 15$$
$$x_1, x_2, x_3, x_4 \geq 0$$

OR

Why Big-M is called penalty? Find optima solution of the following linear programing problem by using Big-M method

$$Minimize\ Z = 12x_1 + 20x_2$$

Subject to the constraints

$$6x_1 + 8x_2 \geq 100;$$
$$7x_1 + 12x_2 \geq 120$$
$$x_1, x_2 \geq 0$$

2. Determine the optimum basic feasible solution to the following transportation problem.

	D_1	D_2	D_3	D_4	Supply
O_1	19	30	50	10	7
O_2	70	30	40	60	9
O_3	40	8	70	20	18
Demand	5	8	7	14	

3. Sample of 100 arrivals of customers at a retail sales department are according to the following distribution.

Time between arrival(min)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Frequency	2	6	10	25	20	14	10	7	4	2

A study of the time required to service customers by adding up the bills, receiving payments and placing packages yields the following distributions

Service time	0.5	1.0	1.5	2.0	2.5	3.0
Frequency	12	21	36	19	7	5

Estimate the average percentage of customer waiting time and average percentage of idle time of the server by simulation for the next 6 arrivals.
Random numbers for arrivals: 93, 22, 53, 64, 39, 07
Random numbers for service: 78, 76, 58, 54, 74, 92

P.T.O.

SECTION "D"

[5 Q. × 5 = 25 marks]

4. An Air Force is experimenting with three types of bombs P, Q and R in which three kinds of explosives, viz., A, B and C will be used. Taking the various factors into account, it has been decided to use the maximum 600 kg of explosive A, at least 480 kg of explosive B and exactly 540 kg of explosive C. Bomb P requires 3, 2, 2 kg, bomb Q requires 1, 4, 3 kg and bomb R requires 4, 2, 3 kg of explosives A, B and C respectively. Bomb P is estimated to give the equivalent of a 2 ton explosion, bomb Q, a 3 ton explosion and bomb R, a 4 ton explosion respectively. Under what production schedule can the Air Force make the biggest bang?

5. Find optimal solution of the following integer linear programming problem

$$Maximize\ Z = 4x_1 + 3x_2$$

Subject to the constraints

$$x_1 + 2x_2 \leq 4$$

$$2x_1 + x_2 \leq 6$$

$$x_1, x_2 \geq 0$$

OR

Find first Gomory's constraint from the following optimal table and display the equation of this constraint into the table below:

		C_j	3	1	3	0	0	0
C_b	B	X_{B_i}	x_1	x_2	x_3	s_1	s_2	s_3
3	x_3	10/3	0	0	1	4/9	1/9	4/9
1	x_2	3	0	1	0	1/3	1/3	1/3
3	x_1	16/3	1	0	0	1/9	7/9	10/9
	$Z_j - C_j$	0	0	0	2	3	5	

6. Obtain the initial basic feasible solution of a transportation problem by any one method.

	D_1	D_2	D_3	D_4	Supply
O_1	21	16	15	3	11
O_2	17	18	14	23	13
O_3	32	27	18	41	19
Demand	6	10	12	15	43

7. A book salesman who lives at city A must call once a month on four customers located in cities B,C,D,E and following table gives the distances in kilometers among the cities. Find the minimum total distance travelled and routing schedule of the book seller.

		To City				
		A	B	C	D	E
From city	A	---	210	150	250	110
	B	210	----	100	80	130
	C	150	100	----	60	105
	D	250	80	60	----	90
	E	110	130	150	90	------

8. A printing machine in an office is operated by a person who does other jobs also. The average service time for a job is 6 minutes per customer. On an average, in every 12 minutes, one customer arrives for printing then find
   a. Percentage of time that an arrival has not to wait
   b. Average time spent by a customer in waiting
   c. Number of customers waiting queue

SECTION "E"

[2 Q. × 2 = 4 marks]

9. If $r_0 = 67, m = 100, p = 29$, compute two random numbers.

10. Discuss CPM.