KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Level : B.Sc.
Year : III
Time : 2 hrs. 30mins.

22 JAN 2024

Course : COMP 317
Semester : I
F. M. : 50

SECTION "B"
[3 Q × 7 = 21 marks]

1. Diet for a sick person must contain at least 4,000 units of vitamins,50 units of minerals and 1,400 units of calories. Two foods A and B are available at a cost of Rs.4 and Rs.3 per units respectively. If one unit of A contains 200 units of vitamins,1 unit of mineral and 40 units of calories and one unit of B contains 100 units of vitamins, 2 units of minerals and 40 calories, Set up the mathematical model as linear programming problem and find by graphical approach what combination of foods be used to have least cost. [3.5+3.5]

2. 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 $Minimize\ Z = 12x_1 + 20x_2$
$Subject\ to\ 6x_1 + 8x_2 \geq 100; 7x_1 + 12x_2 \geq 120; x_1, x_2 \geq 0$

3. Simulation is easier but expensive, justify it. Arrival random numbers are 09,89,38,72,45 and service random numbers are 95,07,38,67,82 for the following probability distribution of arrival time and service time find the following:
   a. Number of waiting customers
   b. Expected idle time of server
   c. Expected time that a customer has to wait
   d. Total time spent by a customer in the system
   e. Mean inter arrival time of customer
   f. Percentage of time that a server remains busy

Inter arrival time(Min)	Prob.	Service time(Min)	Prob
8	0.20	10	0.25
10	0.30	5	0.05
40	0.15	30	0.50
15	0.35	20	
20		40	

SECTION "C"

[5 Q × 5 = 25 marks]

4. Find optimal solution of the following linear programming problem by using Simplex method: $Maximize\ Z = 5x_1 + 7x_2$

Subject to the constraints $-2x_1 + 3x_2 \leq 6; 6x_1 + x_2 \leq 30; x_1, x_2 \geq 0$

OR

Find first Gomory's constraint from the following optimal table and display the equation of this constraint into the table below: [5]

		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

5. 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.

From city	To City				
	A	B	C	D	E
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	------

6. A firm has selling centers at W1, W2, W3, W4 and it has manufacturing plants at 3 places P1, P2, P3 .Table below shows the net profit for each unit, along with manufacturing plants daily production (supply) and seller's daily requirements (demand). Find the optimal schedule to maximize the profit.

	W_1	W_2	W_3	W_4	Supply
P_1	12	15	6	25	200
P_2	8	7	10	15	500
3	12	6	10	20	300
Demand	180	320	100	400	

7. A photo copy 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,every,12 minutes, one customer arrives for photo copy then find [1.5+1.5+2]

a. Percentage of time that an arrival has not to wait
b. Average time spent by the customer
c. Number of customers waiting queue

8. A project has following activities [2+1.5+1.5]

Activity	A	B	C	D	E	F	G	H	I	J
Precedence	---	---	A	A	B,C	B,C	E	E	D,G	F,H,I
Time in weeks	15	15	3	5	8	12	1	14	3	14

a. Draw the network diagram
b. Find the expected time to complete the project
c. Find free float of the non-critical path

SECTION "D"

[2Q × 2 = 4 marks]

9. If $r_0 = 89, m = 100, p = 137$ then compute two random numbers.

10. Discuss integer linear programming problem.

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Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"

[20Q. × 0.5 = 10 marks]

Fill in the blank space(s) by writing the most appropriate word(s) or symbol(s).

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

2. Transportation problem with 5 supply center and 6 demand center should have the total number of constraints = _____.

3. The time for which a machine cannot find a job to start with is called _____.

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

5. Sensitivity analysis is not _____technique.

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

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

8. Final optimal table of transportation problem the possession of at least one d_{ij}=0 indicates _____.

9. While calculating the random number, the initially given random number is known as _____.

10. In M/M/1 queueing system the second M denotes _____.

Fill in the blank spaces (Question number 11 through 20) by choosing the most appropriate answers from among the given ones. **Do not tick the answers.**

11. When LP problem Maximize $Z = 5x_1 + 8x_2 + 10x_3$ subject to constraints $9x_1 + 8x_2 + 20x_3 \geq 10; 15x_1 + 18x_2 + 30x_3 \leq 20, x_1, x_2, x_3 \geq 0$ is solved by Simplex method then number of basic variables in the final table is _____.
[2; 3; 5; 6]

12. The solution of LP problem by simplex method when pivot column possesses the either all negative elements or zero elements or both then this indicate the solution of such problem is _____.
[Unbounded; Infeasible; Multiple solution; Degenerate solution]

13. Degenerate initial solution of transportation is changed into Non-degenerate by assigning small $\epsilon > 0$ to the non-basic cell with _____
[Zero element; Largest positive element;
Least positive element; Negative element]

14. Service mechanism in a queuing system is characterized by_____
[server's behavior; customer's behavior;
customers in the system; arrival behavior]

15. CPM network analysis is useful for_____
[Activity research project; Event development projects;
Event construction projects; Activity construction project]

16. In PERT, probability for expected activity duration is considered to be _____
[99%; 66%; 50%; 40%]

17. Which of the following is not the step of the Monte Carlo Simulation _____
_____
[Modelling the project; Estimate the cost;
Specifying the probabilities; Calculate the present values]

18. Hungarian method is used to solve_____
[(i)Transportation problem; (ii) Assignment problem;
(iii)Travelling Salesman problem; Both (ii) and (iii)]

19. In degenerate solution value of linear programming problem_____
[Increases infinitely; Decreases infinitely;
Basic variables are nonzero; One or more basic variables are zero]

20. The dead bodies coming to a burial ground is an example of _____
[Pure Birth Process; Pure death Process;
Birth and Death Process; Constant rate of arrival]