

KATHMANDU UNIVERSITY  
End Semester Examination  
June/July, 2023

Marks Scored:

Level : B.E.

Year : III

Exam Roll No. :

Time: 30 mins.

Course : COMP 304

Semester : II

F. M. : 20

Registration No.:

Date **07 JUL 2023**

SECTION "A"

[10Q. × 1 = 10 marks]

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

1. If free float of non-critical activity joining nodes 2 and 3 is 5 days, time from node 2 to 3 is 4 days, earliest start time is 3 days then earliest finish time is \_\_\_\_\_.
2. Minimize  $Z = 6x_1 + 7x_2$  subject to constraints  $8x_1 + 9x_2 \geq 10$ ,  $12x_1 + 13x_2 \leq 20$ ,  $x_1, x_2 \geq 0$  has dual objective function as \_\_\_\_\_.
3. In Simplex table the elements of  $Z_j - C_j$  row corresponding to non-basic variables is called \_\_\_\_\_.
4. Degeneracy in transportation problem is removed by \_\_\_\_\_.
5. If the optimistic time, most likely time and pessimistic time respectively are 2,4,6 then expected time of an activity = \_\_\_\_\_.
6. Portion of total float within which an activity can be delayed for start without affecting the floats of preceding activities is called \_\_\_\_\_.
7. While numbering the nodes of project network tail node gets \_\_\_\_\_ than head node.
8. From the perspective of cost of providing the service to the customers out of M/M/2/6 and M/M/6/8 one should choose to use \_\_\_\_\_.
9. If minimize  $Z = 10x_1 + 20x_2$  then profit per unit product of second product is \_\_\_\_\_.
10. If distance travelled is known between pair cities then objective function of travelling salesman problem is minimize  $Z =$  \_\_\_\_\_.

SECTION "B"

[10Q. × 1 = 10 marks]

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

11.

\_\_\_\_\_ is not the assumption of travelling salesman.

- (i) The travelling salesman should come back to home city
- (ii) The priority visit of the city is the prime objective of travelling salesman problem
- (iii) No back-trekking is allowed in the travelling salesman
- (iv) The cost or time or distance between pair city should be known priorly by the salesman

12. If for maximizing primal LP-problem the dual variable  $y_3 = 10$  indicates that \_\_\_\_\_.
- the objective function value decreases by 10 when third resource is increased by unit amount
  - the objective function value increases by 10 when third product is increased by unit amount
  - the objective function value increases by 10 when third resource is increased by unit amount
  - the objective function value decreases by 10 when third product is increased by unit amount
13. Which one of the following is true? \_\_\_\_\_
- The simulation is optimization technique.
  - The simulation generally uses Mathematical Formulas.
  - The simulation is costlier.
  - The simulation cannot be shown physically.
14.  $f(x_1)$  and  $f(x_2)$  are two linear functions then  $f(x_1 + x_2) = f(x_1) + f(x_2)$  indicates  $f$  is \_\_\_\_\_.
- quadratic
  - cubic
  - linear
  - biquadratic
15. If transportation problem has  $(m + n)$  constraints, then number of basic cells =  $(m + n - 1)$  indicates \_\_\_\_\_.
- there are  $mn$  variables dependent
  - there are  $m$  variables dependent
  - there are  $n$  variables dependent
  - there is 1 variable dependent
16. If there are  $n$  workers and  $n$  jobs in the assignment problem then there would be \_\_\_\_\_ solutions.
- $n!$
  - $(n - 1)!$
  - $(n!)^n$
  - $n$
17. Queueing system has capacity for 5 people with arrival 6 per hour and are served at 12 people per hour then the probability of server being idle is \_\_\_\_\_.
- 0.5079
  - 0.5000
  - 0.3333
  - 0.2575
18. Main objective of Assignment problem is to \_\_\_\_\_.
- reduce the cost of assignment to zero
  - reduce the cost of particular assignment to zero
  - minimize the total cost of assignment
  - find feasible solution
19. \_\_\_\_\_ method is used to find optimal solution of transportation problem
- Hungarian
  - MODI
  - Vogel Approximation
  - Two Phase
20. In project network analysis, the path is said to be critical if \_\_\_\_\_.
- $E_j = L_j$  and  $E_i = L_i$
  - $E_j \neq L_j$  and  $E_i = L_i$
  - $E_j = E_i$  and  $L_j = L_i$
  - $E_j \neq E_i$  and  $L_j \neq L_i$

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

Course : COMP 304  
Semester : II  
F.M. : 55

SECTION "C"

[3Q. × 7 = 21 marks]

1. A company produces two products X, Y. These products require three ores A, B, C. The maximum quantities of the ores A, B, C available are 22 tones, 14 tones and 14 tons respectively. For one ton of each of these products, the ores requirements are given in the table below. (a) Set up the Mathematical model of the problem as the linear programming problem. (b) By using graphical approach find how many tones of each product should the company produce in order to maximize its profit. [3.5+3.5]

	X	Y
A	3	—
B	1	2
C	3	2
Profit per tonne (Rs. in Thousand)	1	4

2. The linear programming problem:  $Maximize Z = 5x_1 + 3x_2$  subject to the constraints  $x_1 + x_2 \leq 2$ ;  $5x_1 + 2x_2 \leq 10$ ;  $3x_1 + 8x_2 \leq 12$ ;  $x_1, x_2 \geq 0$  has the following optimal solution table: [7]

$C_j$			5	3	0	0	0
$C_B$	B	$X_{B_i}$	$x_1$	$x_2$	$s_1$	$s_2$	$s_3$
5	$x_1$	2	1	1	1	0	0
0	$s_2$	0	0	-3	0	1	0
0	$s_3$	6	0	5	0	0	1
$Z_j$			5	5	5	0	0
$Z_j - C_j$			0	2	5	0	0

- State optimal solution set.
- State whether the solution is non-degenerate or not.
- State basic variables and non-basic variables.
- Value of  $s_3 = 6$  what does it mean?
- Does this problem possess alternative solution? Give reason.
- State from the table the solution for dual variables.
- What is the new objective function value when  $x_2$  is introduced into solution

**OR**

By using proper simplex method find the optimal solution of the following LP-problem: [7]

$Maximize Z = 4x_1 + 3x_2 + 6x_3$  subject to the constraints

$$3x_1 + 3x_2 + 2x_3 \leq 440$$

$$4x_1 + 3x_3 \leq 470$$

$$2x_1 + 5x_2 \leq 430$$

$$x_1, x_2, x_3 \geq 0$$

3. What the simulation is about? Arrival of customers and service times of customers are having the following distributions. Random numbers for arrivals and service respectively are :36,60,82,14,10 and 34,88,25,19,48 .Simulate this queueing system by using the following: [7]

Inter-arrival time (Min)	Probability	Service time (Min)	Probability
5	0.15	7	0.10
6	0.35	8	0.35
7	0.40	9	0.45
8	0.10	10	0.10

- Find expected time during which the server remains idle.
- Find expected number of customers waiting.
- Find expected time that a customer has to wait.
- Find mean service time of a customer.
- Find mean inter-arrival time of a customer.
- Find percentage of time during which the server remains idle.

SECTION "D"

[5Q. × 6 = 30 marks]

4. An architect has been awarded a contract to prepare a plan for an urban renewal project. The job consists of following activities and their estimated times: [2+2+2]

Activity	A	B	C	D	E	F	G
Immediate predecessors	–	–	A	A,B	C,D	B	E,F
Time (days)	2	1	3	2	1	3	1

- Draw the project network diagram.
  - Find expected total time to complete the project.
  - Find the total float of the non-critical activities.
5. Use Big-M method to find optimal solution of the following linear programming problem:

$$\begin{aligned} \text{Maximize } Z &= 5x_1 + 3x_2 \\ 2x_1 + 4x_2 &\leq 12; 2x_1 + 2x_2 = 10; 5x_1 + 2x_2 \geq 10; x_1, x_2 \geq 0 \end{aligned}$$

**OR**

Find optimal solution of the following primal by using the optimal solution of its dual:

$$\begin{aligned} \text{Minimize } Z &= 2x_1 + 4x_2 \\ 2x_1 + x_2 &\geq 14; x_1 + 3x_2 \geq 18; x_1 + x_2 \geq 12; x_1, x_2 \geq 0 \end{aligned}$$

6. In a car-wash facility cars arrive for service according to Poisson distribution with mean 5 per hour. The time for washing and cleaning each car has exponential distribution with mean 10 minutes per car. The facility cannot handle more than one car at a time and has a total of 5 parking spaces.(a) Find effective arrival rate (b) what is the probability that an arriving car will get service immediately upon arrival? (c) Find the mean time that a car has to spend in the system. [2+2+2]

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7. Profit matrix of transportation problem has been given below. Find optimal solution.

From\TO	A	B	C	D	Availability
P	14	11	13	14	60
Q	12	13	12	12	35
R	13	15	12	14	80
Requirements	32	45	30	28	

8. How assignment problem differs from transportation problem? A sales manager has to assign 4 salesmen to 4 territories. The possible profit for each salesman in each territory is given below. Find the assignment schedule that maximizes the total profit. [1+5]

Salesmen	Territories			
	A	B	C	D
W	35	27	28	37
X	28	37	29	40
Y	35	24	32	33
Z	24	32	25	28

SECTION "E"

[2Q. × 2 = 4 marks]

9. Discuss Redundancy in constraints.
10. Convert following Assignment problem into linear programming problem.

	A	B	C
X	2	3	4
Y	8	6	5
Z	9	10	11

