KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : COMP 304
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 08 AUG 2024

SECTION "A"

[10 Q. × 1 = 10 marks]

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

1. If latest finish time of the 6^{th} node is 9 days, earliest start time of 5^{th} node is 5 days and time taken to complete this activity is 2 days then the total float of this activity is given by _____
2. Minimize $Z = 6x_1 + 4x_2$ has vertices convex polygon as $(2,3), \left(5, \frac{1}{2}\right), \left(\frac{1}{2}, 5\right), \left(\frac{1}{3}, \frac{1}{2}\right)$ then optimal value vertex is _____
3. If there are m cities then a traveling salesman has to travel these cities in _____ _____ ways
4. Queueing theory is the science of _____
5. If the optimistic time, most likely time and pessimistic time respectively are 4,6,14 then expected time of an activity = _____
6. The transportation problem has the demand amount more than supply amount then before finding the initial solution we have to introduce _____
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 outs of M/M/4/7 and M/M/10/5 one should choose to use _____
9. If minimize $Z = 8x_1 + 9x_2$ then cost per unit product of first product is _____
10. If $r_0 = 275, m = 1000, p = 563$ *then* $r_1 =$ _____

SECTION "B"

[10 Q. × 1 = 10 marks]

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

11. If for minimizing primal LP-problem the dual variable $y_5 = 100$ indicates that_____

[The objective function value decreases by 100 when fifth resource is increased by unit amount
The objective function value increases by 100 when fifth resource is increased by unit amount
The objective function value increases by 100 when fifth product is decided to not to produce.
The objective function value decreases by 100 when fifth product is increased by unit amount]

12. _____is not the assumption of travelling salesman

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

13. _____ is not the term of queueing model

[Arrival Waiting Service Delay]

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. Which one of the following is true_____

[Every LP problem has at least one optimal solution
Every LP problem has a unique solution
If an LP problem has two optimal solutions, then it has infinitely many solutions
If a feasible solution is unbounded then LP has no solution]

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 4 people with arrival 4 per hour and are served at 5 people per hour then the effective arrival rate is _____

[2.952 2.953 2.954 2.955]

18. Problem gets optimal solution for assignment problem but not for travelling salesman problem then to find the optimal solution for travelling salesman problem we have to proceed _____

[to draw minimum number of vertical and horizontal line to cover all the zero
to add dummy row
to extract the new matrix corresponding to least cost
to extract the new matrix corresponding to largest cost]

19. Loop starts from the ----------cell in MODI method of transportation problem that has

[Largest $d_{ij} > 0$ Largest $d_{ij} < 0$ $d_{ij} = 0$ Least $d_{ij} > 0$]

20. Which one of the following is not appropriate in the Monte Carlo simulation technique__

_____

[It uses random numbers It is probabilistic approach technique
It uses conventional formula It is not optimization technique]

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SECTION "C"
[3 Q. × 7 = 21 marks]

1. What is the great role of Big-M in Charne's Big-M method? Use it to find the optimal solution of following LP-problem: $Maximize\ Z = 3x_1 + 2x_2 + 3x_3$ subject to the constraints

$$2x_1 + x_2 + x_3 \leq 2\ ; 3x_1 + 4x_2 + 2x_3 \leq 8\ ;\ x_1, x_2, x_3 \geq 0$$

OR

$Maximize\ Z = 5x_1 + 3x_2$ 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:

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

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

2. In a KUSMS Teaching hospital, Dhulikhel patients' arrival is considered to be Poisson with an inter-arrival time of 10 mins. The doctor's examination time assumed to be exponentially distributed with an average of 6 min. [2+1+2+2]
a. What is the chance that a new patient directly sees the doctor?
b. For what proportion of the time the doctor is busy?
c. What is the average number of patients in the system?
d. What is the average waiting time of the system?

P.T.O.

3. In a single server queueing system, the arrival random number numbers 87,06,89,99,39 and service random numbers 12,56,92,76,55 with the following probabilities distributions of the interarrival and service times. System starts at 10:00 AM

Inter-arrival time (Min)	Prob	Service time (Min)	Prob.
5	0.15	15	0.20
10	0.25	10	0.15
3	0.17	5	0.35
8	0.13	8	0.30
2	0.40	10	

a. Find the mean number of customers waiting in queue
b. Find the mean time that a customer has to wait in queue
c. Find the mean time that the server remains idle
d. Find the mean inter-arrival time
e. Find the mean service time of a customer that he/she receives
f. Find mean time that a customer has to spent from arrival to departure
g. Find the percentage of time during which server remains busy

SECTION "D"
[5 Q. × 6 = 30 marks]

4. What is the indication that LP-problem possesses the multiple optimal solutions by Simplex method? by using this method find two optimal solutions of [1+5]

$Maximize\ Z = 3x_1 + 3x_2$ subject to the constraints

$x_1 + x_2 \leq 5\ ; x_1 + 2x_2 \leq 6\ ;\ x_1, x_2 \geq 0$

OR

In what way does the Two Phase method differ from Big-M method? Find optimal solution of the following linear programming problem by using two phase method:

$Maximize\ Z = 7.5x_1 - 3x_2$ subject to

$3x_1 - x_2 - x_3 \geq 3; x_1 - x_2 + x_3 \geq 2\ ;\ x_1, x_2, x_3 \geq 0$

5. A lead draftsman has five drafting tasks to accomplish and five idle draftsmen. Each draftsman is estimated to require the following number of hours for each task. If each draftsman costs the company Rs.20 per hour, including overhead [4+2]

Draftsman		A	B	C	D	E
	P	60	50	100	85	95
	Q	65	45	100	75	90
	R	70	60	110	97	85
	S	70	55	105	90	93
	T	60	40	120	85	97

a. Find the optimal assignment of draftsman to the tasks that will result to the minimum total cost
b. Find total cost.

6. A sociologist plans a questionnaire survey, consisting of the following tasks [2+2+2]

Activity	Descriptions	Immediate predecessors	t_0	t_m	t_p
A	Desing of questionaire	---	4	5	6
B	Sampling design	---	8	12	16
C	Testing of questionnaire and refinement	A	4	5	12
D	Recruiting of interviewers	B	1	3	5
E	Training of interviewers	D, A	2	2	2
F	Allocation of area to interviewers	B	4	5	6
G	Conducting interview	C, E, F	10	14	18
H	Evaluation of Results	G	18	20	34

a. Draw the network diagram
b. Find critical path and expected time to complete the project
c. What is the probability that the project can be completed in 60 days

7. Three factories X, Y, Z in the country produces the sanitizer and supplies to dealers A, B, C, D the demand, supply quantities and profit per unit product have been given in the table below then find the net return of the company.

	A	B	C	D	Capacity
X	12	18	6	25	100
Y	8	7	10	18	400
Z	14	3	11	20	200
Demand	100	120	280	150	

8. KU-furniture department cuts raw timber form its premises -Utish and Salla logs for wooden boards. Two steps are required to produce boards from logs. The first step involves removing the bark from the logs. Two hours are required to remove the bark from 1,000 feet of Utish logs and three hours per 1,000 feet of Salla logs. After the logs have been debarked ,they must be cut into boards .It takes 2.4 hours per 1,000 feet of Utish logs to be cut into boards and 1.2 hours per 1,000 feet of Salla logs .The bark removing machines can operate for up to 60 hours per week ,while for cutting machines this number is limited to 48 hours per week .The company can buy a maximum of 18,000 feet of raw Utish logs and 12,000 feet of raw Salla logs each week .The profit per 1,000 feet of processed logs is Rs1,800 and Rs.1,200 for Utish and Salla logs respectively. [3+3]

a. Formulate this problem as linear programing problem.
b. Find by graphical method how many feet of each type of log should be processed each week in order to maximize the profit?

SECTION "E"

[2 Q. × 2 = 4 marks]

9. Differentiate between CPM and PERT.

10. State five assumptions of traveling salesman problem with its Mathematical formulation.