Reg. No. : .....

Code No. : 5767 Sub. Code : WMAE 25

M.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2024.

Second Semester

Mathematics

Elective — OPERATIONS RESEARCH

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. _____ is an improved version of the least-cost method.

(a) North-west

(b) VAM

(c) Simplex

(d) Transportation

2. A transportation problem is said to be balanced if the total demand is _____ to the total supply.

(a) greater than

(b) less than

(c) equal

(d) not equal

3. The assignment problem will be solved by _____ method.

(a) Least cost

(b) North west corner

(c) Vogel's approximation

(d) Hungarian

4. _____ algorithm is to determine the shortest routes between the source node and every other nodes in the network.

(a) Floyd's (b) Vogel's

(c) Prim's (d) Dijkstra's

5. A _____ is a sequence of distinct branches that join two nodes regardless of the direction of flow in each branch.

(a) path (b) arc

(c) node (d) loop

6. A network consists of a set of _____ linked by arcs.

(a) flow (b) lines

(c) nodes (d) ordinary

7. Which operation is used in Floyd's algorithm?

(a) One (b) Double

(c) Triple (d) Arc

8. A constraint equation can be used as a _____ for generating a cut provided its right hand side is fractional.

(a) column

(b) source row

(c) normal

(d) conjugate

9. For solving LLP problems with pure binary (zero or one) variables _____ algorithm was developed.

(a) additive

(b) irregular

(c) multiplicative

(d) divide

10. The _____ problem involves placing and receiving orders of given sizes periodically.

(a) queuing

(b) deterministic

(c) inventory

(d) complexity

11. New orders are placed when the inventory level drops to a prespecified level called the _____ point.

(a) Setup (b) Reorder

(c) Purchase (d) Holding

12. The cost associated with penalty incurred when we run out of stock is called _____.

(a) set up cost

(b) holding cost

(c) shortage

(d) carrying cost

13. The arrival of customers is represented by the _____ time between successive customers.

(a) inter arrival

(b) facility

(c) service time

(d) none

14. The expected waiting time in the queue is denoted by _____.

(a) w_s (b) w_q

(c) L_q (d) L_s

15. The expected number of customers in the queue L_q is _____.

(a) $\frac{\rho^2}{1-\rho}$ (b) $\frac{\rho}{1-\rho}$

(c) $\frac{\rho^3}{1-\rho}$ (d) $\frac{\rho^4}{1-\rho}$

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

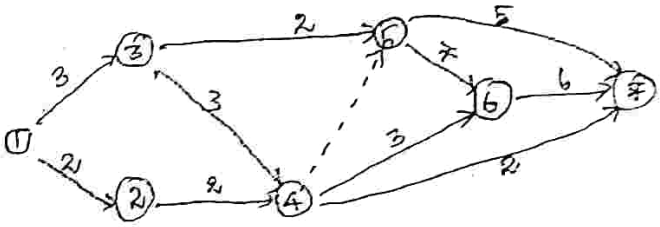
16. (a) Write the steps involved in North West Corner Method.

Or

(b) Solve the assignment problem.

	1	2	3	4
I	1	4	6	3
II	9	7	10	9
III	4	5	11	7
V	8	7	8	5

17. (a) Find the critical path for the network given below :



Or

(b) Write Dijkstra's algorithm.

18. (a) Convert the following 0-1 problem to satisfy the starting requirements of the additive algorithm.

Maximize $z = 3x_1 - 5x_2$ sub to

$x_1 + x_2 = 5$

$4x_1 + 6x_2 \geq 4, \quad x_1, x_2 = (0, 1)$

Or

(b) Write the Branch and Bound Algorithm.

19. (a) If $k = \$100$, $h = \$0.05$, $D = 30$ units per day and lead time is 30 days determine the optimal inventory policy and the associated cost per day.

Or

(b) Discuss about General Inventory Model.

20. (a) Babies are born in a sparsely populated state at the rate of one birth every 12 mts. The time between births follows an exponential distribution. Find (i) The average number of births per year, (ii) The probability that no births will occur in any one day, (iii) The probability of issuing 50 birth certificates in 3 hours given that 40 certificates were issued during the first 2 hours of the 3-hour period.

Or

(b) Derive $p_n(t)$ for the pure birth model.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

21. (a) Given $x_{12} = 15$, $x_{23} = 15$, $x_{24} = 10$, $x_{22} = 10$, $x_{31} = 5$, $x_{34} = 5$. Is it an optimal solution to the transportation problem?

10	2	20	11	15
12	7	9	20	25
4	14	16	18	10
5	15	15	15	50

Or

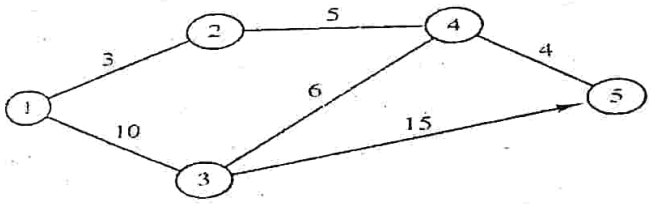
(b) Solve the following transportation problem using Vogel's approximation method.

	1	2	3	4	
1	10	2	20	11	15
2	12	7	9	20	25
3	4	14	16	18	10
	5	15	15	15	

22. (a) Explain in detail about the Floyd's Algorithm.

Or

(b) For the given network find the shortest routes between every two nodes. The distances are given on the arcs. Arc (3, 5) is directional so that no traffic is allowed from node 5 to node 3. All other arcs allow in both directions.



23. (a) Solve the 0-1 problem.

Maximize $z = 3y_1 + 2y_2 - 5y_3 - 2y_4 + 3y_5$ subject to

$y_1 + y_2 + y_3 + 2y_4 + y_5 \leq 4$

$7y_1 + 3y_3 - 4y_4 + 3y_5 \leq 8$

$11y_1 - 6x_2 + 3y_4 - 3y_5 \geq 3.$ $\quad y_1, y_2, y_3, y_4, y_5 = (0, 1)$

Or

(b) Maximize $z = 5x_1 + 4x_2$ subject to

$x_1 + x_2 \leq 5$

$10x_1 + 6x_2 \leq 45$ $\quad x_1, x_2$ non negative integer.

24. (a) Explain the Multi-item EOQ with Storage Limitation.

Or

(b) The following data describe 3 inventory items. Determine the optimal order quantities.

Item i	ki $	Di unit/day	hi ($)	ai (ft2)
1	10	2	.3	1
2	5	4	.1	1
3	15	4	.2	1

25. (a) Visitors' parking at Ozark college is limited to five spaces only. Cars making use of this space arrive according to a Poisson distribution at the rate of six per hour. Parking time is exponentially distributed with

a mean of 30 minutes. Visitors who cannot find an empty space on arrival may temporarily wait inside the lot until a parked car leaves. The temporary space can hold only three cars. Others cars that cannot park or find a temporary waiting space must go elsewhere.

Determine

(i) The probability p_n of n cars in the system.

(ii) The effective arrival rate for cars that actually use the lot.

(iii) The average number of cars in the lot.

(iv) The average time a car waits for a parking space inside the lot.

(v) The average number of occupied parking spaces.

Or

(b) Automatic car wash facility operates with only one bay. Cars arrive according to a Poisson distribution with a mean of 4 cars per hour and may wait in the facility's parking lot if the bay is busy. The time for washing and cleaning a car is exponential. with a mean of 10 minutes. Cars that cannot park in the lot can wait in the street bordering the wash facility. Determine the size of the parking lot.
