KAMARAJ COLLEGE (Autonomous)

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(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(7 Pages) **Reg. No:……**

Question Code: 26E00810 **Course Code : 24PEMA25/25PEMA25**

PG Degree - End Semester Examinations, April 2026

Second Semester

M.Sc., MATHEMATICS

Operation Research

(For those who joined in July 2024 and June 2025 onwards)

Time : 3Hours **Maximum : 75 Marks**

PART – A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

CO:1 K:1 1. The _____ linking the sources and destinations represent the routes between them.

(a) Node (b) Sources

(c) Arcs (d) Destinations

CO:1 K:2 2. The application of the transportation model is not limited to _____ commodities between geographical sources and destinations.

(a) Transporting (b) Inventory

(c) Source (d) Supply

CO:2 K:1 3. A path forms a _____ if it connects a node to itself.

(a) Network (b) Loop

(c) Directed (d) Tree

CO:2 K:2 4. A _____ network is one in which every two distinct nodes are linked by at least one path.

(a) Tree (b) Directed

(c) Path (d) Connected

CO:3 K:1 5. The first special 0-1 algorithm is called the _____ algorithm.

(a) Additive (b) Zero-one

(c) One at a time (d) Optimum

CO:3 K:2 6. The cutting plane algorithm starts by solving the continuous _____.

(a) Source row (b) LPP

(c) Fractional cut (d) Mixed cut

CO:4 K:1 7. The effective lead time L_e = _____.

(a) $L - nt_0^*$ (b) nt_0^*

(c) $L + nt_0^*$ (d) Lnt_0^*

CO:4 K:2 8. _____ cost represents the cost of maintaining the inventory in stock.

(a) Purchasing (b) Setup

(c) Shortage (d) Holding

CO:5 K:1 9. The principal actors in a queuing situation are the _____ and the _____.

(a) Source, Facility (b) Queue, Jockey

(c) Customer, Sever (d) Finite, Infinite

CO:5 K:2 10. The relationship between W_s and W_q is known as little's formula, which is _____.

(a) $W_s = W_q + \frac{1}{\mu}$ (b) $W_s = W_q - \frac{1}{\mu}$

(c) $W_s = W_q + \mu$ (d) $W_s = W_q - \mu$

PART – B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 250 words.

CO:1 K:3 11. (a) Solve an initial basic feasible solution to the following transportation problem using Northwest-Corner method

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

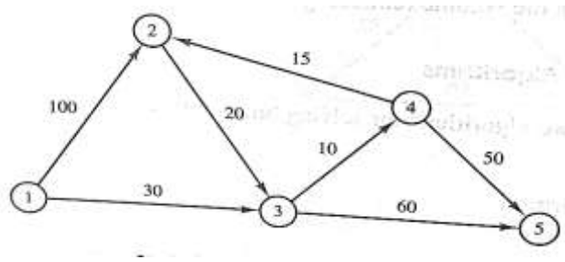
(OR)

(b) Develop Vogel Approximation Method.

CO:2 K:4 12. (a) Analyze minimal spanning tree algorithm.

(OR)

(b) Apply Dijkstra's algorithm to the network; determine the shortest routes from city 1 to each of the remaining four cities.



CO:3 K:3 13. (a) A publisher has a contract with an author to publish a textbook. The activities associated with the production of the textbook are given subsequently. Develop the associated network for the project.

	Activity	Predecessor(s)	Duration(weeks)
A:	Manuscript proofreading by editor	--	3
B:	Sample pages prepared by typesetter	--	2
C:	Book cover design	--	4
D:	Preparation of artwork for book figures	--	3
E:	Author's approval of edited manuscript & sample pages	A,B	2
F:	Book typesetting	E	4
G:	Author checks typeset pages	F	2
H:	Author checks artwork	D	1
I:	Production of printing plates	G,H	2
J:	Book production and binding	C,I	4

(OR)

(b) Explain forward pass in CPM.

CO:4 K:4 14. (a) Five projects are being evaluated over a 3-year planning horizon. The following table gives the expected returns for each project and the associated yearly expenditures.

Project	Expenditures (million $)/yr			Returns (million $)
	1	2	3	
1	5	1	8	20
2	4	7	10	40
3	3	9	2	20
4	7	4	1	15
5	8	6	10	30
Available funds (million $)	25	25	25	

Examine the projects to be executed over the 3-year horizon.

(OR)

(b) Classify the following LPP by B&B algorithm

Maximize $z = 5x_1 + 4x_2$

Subject to

$x_1 + x_2 \leq 5, 10x_1 + 6x_2 \leq 45, x_1, x_2 \geq 0.$

CO:5 K:3 15. (a) Babies are born in a sparsely populated state at the rate of one birth every 12 minutes. The time between births follows an exponential distribution. Find out the following

(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 by the end of the next 3 hours, given that 40 certificates were issued during the least 2 hours.

(OR)

(b) Develop (M/M/1) : (GD/∞/∞) queuing models.

PART – C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).
Answer should not exceed 600 words.

CO:1 16. (a) Compute an initial basic feasible solution to the following

K:3 transportation problem using Vogel approximation method.

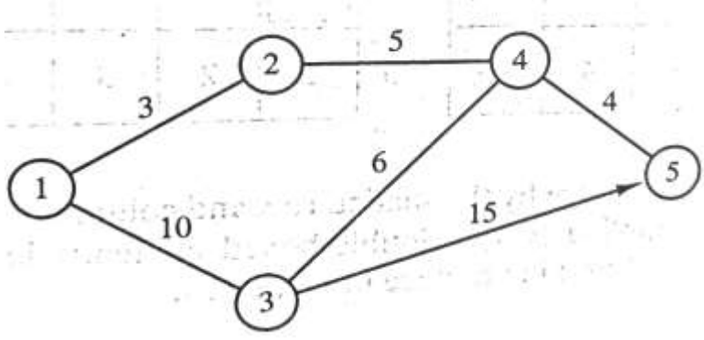
	1	2	3	4	Supply
1	10	2	20	11	15
2	12	7	9	20	25
3	4	14	16	18	10
Demand	5	15	15	15	

(OR)

(b) Solve the following assignment problem using the Hungarian method.

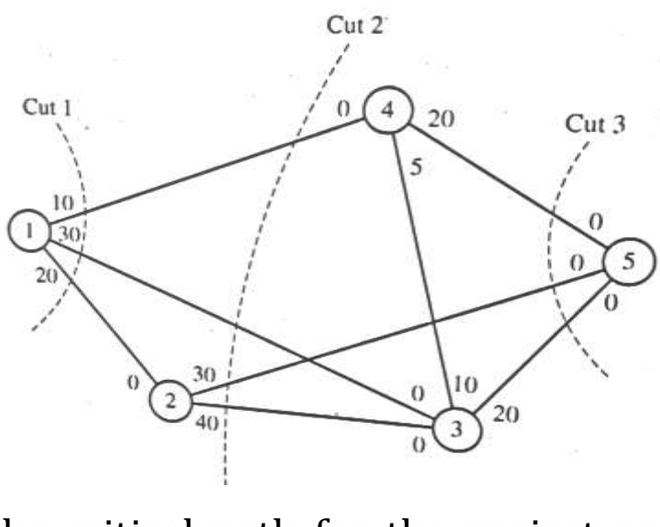
$15	$10	$9
$9	$15	$10
$10	$12	$8

CO:2 K:4 17. (a) Examine the shortest routes between every two nodes. The distances (in miles) are given on the arcs (3, 5) is directional. So that no traffic is allowed from node 5 to node 3. All the other arcs allow traffic in both directions using Floyd's algorithm.



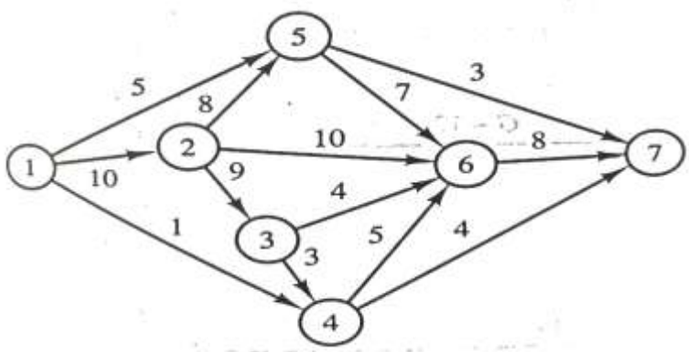
(OR)

(b) Classify the following network using maximal flow method.



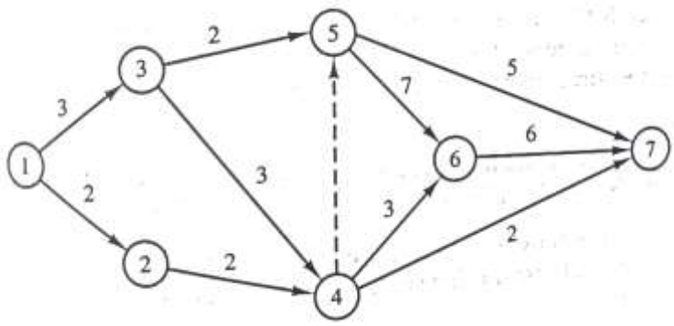
CO:3 18. (a) Determine the critical path for the project network in the

K:5 following Figure. All the durations are in days.



(OR)

(b) Estimate the critical path for the project network in the following Figure. All the durations are in days.



CO:4 K:5 19. (a) Determine by the additive algorithm

Maximize $w = 3y_1 + 2y_2 - 5y_3 - 2y_4 + 3y_5$

Subject to

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

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

$11y_1 - 6y_2 + 3y_4 - 3y_5 \geq 3$

$y_1, y_2, y_3, y_4, y_5 = (0,1)$

(OR)

(b) Demonstrate graphically how the cutting plane algorithm may be used to estimate the following ILP.

Maximize $z = 7x_1 + 10x_2$

Subject to

$-x_1 + 3x_2 \leq 6$

$7x_1 + x_2 \leq 35$

$x_1, x_2 \geq 0$

CO:5 K:6 20. (a) Formulate (M/M/1) : (GD/N/∞) queuing models.

(OR)

(b) Visitor's 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 cars per hour. Parking

time is exponentially distributed with a mean of 30 minutes. Visitors who cannot find an empty space immediately on arrival may temporarily wait inside the lot until a parked car leaves. That temporary space can hold only three cars. Other cars that cannot park or find a temporary waiting space must go elsewhere. Elaborate the following:

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

(ii) The effective rate at which cars arrive at 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.