

- 1-d. The allocation cells in the transportation table is called (CO2) 1
- (a) Unoccupied
 - (b) Occupied
 - (c) Finite
 - (d) empty
- 1-e. Two person zero sum game means that (CO3) 1
- (a) Sum of losses to one player equals the sum of gains to other player.
 - (b) Sum of losses to one player is not equal to the sum of gains to other.
 - (c) Both (a) and (b).
 - (d) None of the above.
- 1-f. Maximization assignment problem is transformed into a minimization problem by (CO3) 1
- (a) Adding each entry in a column from the maximum value in that column
 - (b) Subtracting each entry in a column from maximum value in that column
 - (c) Subtracting each entry in the table from the maximum value in that table
 - (d) All three
- 1-g. Traffic intensity in Queuing theory is also called (CO4) 1
- (a) Service factor
 - (b) Arrival rate
 - (c) Utilization factor
 - (d) Consumption factor
- 1-h. The sequencing order of n-jobs on three machines A,B and C in the order ABC can be obtained if (CO4) 1
- (a) The smallest processing time for machine A \geq the largest processing time for machine B.
 - (b) The smallest processing time for machine C \geq the largest processing time for machine B.
 - (c) Both (a) and (b).
 - (d) None of these.
- 1-i. Replacement of an item become necessary when (CO5) 1
- (a) an old item becomes too expensive to operate or maintain
 - (b) when your operator desires to work on a new machine

(c) when your opponent changes his machine in his unit

(d) when the company has surplus funds to spend

1-j. In a PERT the maximum time that is required to perform the activity under extremely bad conditions is known as (CO5) 1

(a) Normal time

(b) Optimistic time

(c) Most likely time

(d) Pessimistic time

2. Attempt all parts:-

2.a. What is a model? (CO1) 2

2.b. How do we balance an unbalanced transportation model? (CO2) 2

2.c. What is saddle point in game theory? (CO3) 2

2.d. If arrival rate of cutomers in a system is 3 per minute and mean service rate is 4 per minute, find utilization factor. (CO4) 2

2.e. Write the two major differences between PERT and CPM. (CO5) 2

SECTION B

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3. Answer any five of the following:-

3-a. Define LPP and what are the assumptions of LPP? (CO1) 6

3-b. Solve the given LPP by Graphical Method (CO1) 6

Minimize the Objective function

$$Z = 20x_1 + 10x_2$$

$$x_1 + 2x_2 \leq 40$$

$$3x_1 + x_2 \geq 30$$

$$4x_1 + 3x_2 \geq 60$$

Such that $x_1, x_2 \geq 0$

3-c. Find initial basic feasible solution by using Vogel's approximation method of the following transportation problem. (CO2) 6

	D ₁	D ₂	D ₃	Sup ply
O ₁	6	8	14	14

O ₂	4	3	8	12
O ₃	1	2	6	5
Dem and	6	10	15	

- 3-d. Explain the North-West Corner rule for finding the initial basic feasible solution of transportation problem with example. (CO2) 6
- 3.e. By using Hungarian method ,find the assignment of salesmen to various districts which will yield maximum profit. (CO3) 6

	I	II	III	IV
A	16	10	14	11
B	14	11	15	15
C	15	15	13	12
D	13	12	14	15

- 3.f. Customers arrive at the first class ticket counter of a theatre at the rate of 12 per hour. There is one clerk serving the customers at the rate of 30 per hour. (CO4) 6
- (i) What is the probability that there is no customer in the counter(i.e. that the system is idle)?
- (ii) What is the probability that there are more than 2 customers in the counter?
- (iii) What is the probability that there is no customer waiting to be served?
- 3.g. What are three strategies of replacement of items which follow sudden failure mechanism? Explain each of them with example. (CO5) 6

SECTION C

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4. Answer any one of the following:-

4 What is OR? Discuss historical background of OR and describe the necessity of OR in Industry. (CO1) 10

4 **Solve the following LP problem by Simplex Method** 10

$$\text{Maximize } Z = 3x_1 + 2x_2$$

$$\text{Subject to } x_1 + x_2 \leq 4$$

$$x_1 - x_2 \leq 2$$

$$\text{and } x_1, x_2 \geq 0$$

(CO1)

5. Answer any one of the following:-

5-a. Solve the following transportation problem and find the optimal solution (CO2) 10

Origins	Destinations				Available
	P	Q	R	S	
A	21	16	25	13	11
B	17	18	14	23	13
C	32	17	18	41	19
Required	6	10	12	15	

5-b. Solve the following transportation problem by using MODI Method (CO2) 10

	P	Q	R	S	Supply
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

6. Answer any one of the following:-

6-a. Give the mathematical formulation of the assignment problem. Explain the differences between a transportation problem and the assignment problem. (CO3) 10

6-b. Solve the following 6*2 game graphically whose payoff matrix is given by: (CO3) 10

Player A	Player B	
	1	-3
	3	5
	-1	6
	4	1
	2	2
	-5	0

7. Answer any one of the following:-

7-a. Find the optimal sequence for processing nine jobs through the machines A, B, C in the order ABC. Processing times are given below in hours. Find the total elapsed time for the optimal sequences. Also find out the idle time. (CO4) 10

Job	1	2	3	4	5	6	7	8	9
Machine A	4	9	5	10	6	12	8	3	8
Machine B	6	4	8	9	4	6	2	6	4
Machine C	10	12	9	11	14	15	10	14	12

7-b. What is Queuing Theory? Also explain queueing system. Discuss the essential features of queueing system. (CO4) 10

8. Answer any one of the following:-

8-a. The following mortality rates have been observed for a certain type of light bulbs: (CO5) 10

Year	1	2	3	4	5
Percent failing by the end of week	10	25	50	80	100

There are 1000 bulbs in use and it costs Rs. 2 to replace an individual bulb, which has burnt out. If all the bulbs were replaced simultaneously, it would cost 50 paise per bulb. It is proposed to replace all bulbs at fixed intervals, whether or not they have burnt out and to continue replacing burnt out bulbs as they fail. At what intervals should all the bulbs be replaced?

8-b. A small project is composed of seven activities, whose time estimates are listed in the table as follows: (CO5) 10

Activity	Estimated duration (weeks)		
	Optimistic (a)	Most likely (m)	Pessimistic (b)
1-2	1	1	7
1-3	1	4	7
2-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

You are required to:

- i. Draw the project network and find the expected project length.
- ii. Find the expected duration and variance of each activity.
- iii. Calculate the variance and standard deviations of project length.