

**ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, TEKKALI  
(AUTONOMOUS)**

**I M.Tech. II Semester Supplementary Examinations, July, 2025**

**OPERATIONS RESEARCH**

**(Common to All Branches)**

**Time: 3 Hours**

**Max Marks:60**

**Answer any FIVE questions**

**All questions carry EQUAL marks**

1. Solve the following linear programming problem using Simplex Method to **[12 M]**

Maximize  $Z = 3x_1 + 4x_2 + x_3$

Subject to:

$$x_1 + 2x_2 + x_3 \leq 6$$

$$2x_1 + 2x_3 \leq 4$$

$$3x_1 + x_2 + x_3 \leq 9$$

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

2. The time estimates (in weeks) for the activities of a PERT network are given below:

Activity	$t_o$	$t_m$	$t_p$
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

- i) Draw the project network and identify critical path  
 ii) Determine the expected project completion time. ( $t_o$ -optimistic time,  $t_m$ -most likely time,  $t_p$ -pessimistic time). **[12 M]**

3. A company has three plants A,B,C and three ware houses X,Y,Z Number of units available at the plant is 10,15,40 respectively. Demand at X,Y,Z are 20,15,30 respectively. Transportation cost per unit in rupees is given in the following table. Find initial basic feasible solution by (a) North-West method (b) Least cost method.

**[12 M]**

	X	Y	Z	Available
A	5	1	8	10
B	9	4	0	15
C	17	6	7	40
Required	20	15	30	

4. A Company has four machines are available to do four different jobs time in hours that each machine take to do each job is known and given the following table. Determine the assignment of machine to jobs that will minimize the total time. **[12M]**

**Jobs**

**Machines**

	J <sub>1</sub>	J <sub>2</sub>	J <sub>3</sub>	J <sub>4</sub>
M <sub>1</sub>	18	26	17	11
M <sub>2</sub>	13	28	14	26
M <sub>3</sub>	38	19	18	15
M <sub>4</sub>	19	26	24	10

5. (a) Explain the characteristics of queuing theory. **[6M+6M]**  
 (b) A department store has only one cashier. During the rush hours customer arrives at a rate of 20 customers per hour. The average number of customers that can be handled by the cashier is 24 customers per hour. Assume that the condition for use of the single channel queuing model determine (a) Utilization parameter (or) Traffic intensity (b) Average number of customers in the queue. (c) Average number of customers in the system (d) Average time a customer spend in the queue (e) Average number of customer spend in the system
6. a) Explain 2x2 zero sum game, Max mini principle, mini max principle. **[6M]**  
 b) Solve the following game. **[6M]**

Player-A	Player-B	
	B <sub>1</sub>	B <sub>2</sub>
	A <sub>1</sub>	0      5
	A <sub>2</sub>	-2     4

7. Construct the network diagram for the following data. Calculate (a) Critical path (b) Project completion time (c) Total float **[12 M]**

Activity	Duration (Days)
1-2	2
1-3	5
1-4	4
3-4	5
2-5	7
2-6	3
3-6	3
4-6	6
4-7	2
5-8	5
6-8	4
6-9	3
7-9	12
8-9	8

8. State Kuhn tucker conditions and explain how Kuhn tucker conditions can be used to solve a nonlinear programming problems. **[12 M]**

1. Solve the following linear programming problem using graphical method or simplex method. 12M

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

$$\text{Subject to: } 3x_1 + x_2 \leq 12$$

$$4x_1 + 3x_2 \leq 6$$

$$x_1 + 2x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

2. Find the optimum solution to the following assignment problem for which the machining time in hours are given below. 12M

	A	B	C	D
I	3	4	6	8
II	2	8	11	5
III	7	5	2	4
IV	2	1	9	8

3. A company has 3 factories A, B and C which supply units to warehouses X, Y and Z every month. The capacities of the factories are 60, 70 and 80 units at A, B and C respectively. The requirements of X, Y and Z per month are 50, 80 and 80 units respectively. Transportation cost per unit in rupees is given in the following table. Find initial basic feasible solution by (a) Matrix minima method (b) Vogel's approximation method. 12M

	X	Y	Z	Supply
A	8	7	5	60
B	6	8	9	70
C	9	6	5	80
Demand	50	80	80	

4. State Kuhn Tucker conditions and explain how Kuhn Tucker conditions can be used to solve a nonlinear programming problems. 12M

5. Construct the network diagram for the following data of a project also calculate total project duration, critical path and total float 12M

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-7	5-8	6-8	7-9	8-9	9-10
Duration (days)	2	2	2	4	5	8	4	2	4	5	3	4

6. An airport has a single runway. Airplanes have been found to arrive at the rate of 12 per hour. It is estimated that each landing takes 4 minutes. Assuming a Poisson process for arrivals and an exponential distribution for landing times, use an M/M/1 model and determine the following performance measures. (a) Runway utilization (b) Expected number of airplanes waiting to land (c) Expected waiting time (d) Probability that the waiting will be more than 5 minutes. 12M

7. Solve the following game by applying dominance rules. 12M

A	B				
		I	II	III	IV
	I	19	6	7	5
	II	7	3	14	6
	III	12	8	18	4
	IV	8	7	13	-1

8. The time estimates (in weeks) for the activities of a PERT network are given below: 12M

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- i) Draw the project network and identify critical path ii) Determine the expected project completion time. ( $t_o$ -optimistic time,  $t_m$ -most likely time,  $t_p$ -pessimistic time).