(3 Hours) **Total Marks: 80**

N.B: (1) Question no.**1** is **compulsory.**

(2) Attempt any **three** questions from remaining **five** questions.

(3) **Figures** to the **right** indicate **full** marks.

(4) Assume suitable data if necessary.

Q1.

(a) Explain the difference between assignment and transportation models. **[05]**

(b) Write a short note on Minimal Spanning Tree Algorithm. **[05]**

(c) Explain the terms: **[05]**

(i) Inventory carrying cost

(ii) Optimal order quantity**.**

(d) A T.V mechanic finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in the order in which they come in, and if the arrival of sets follow Poisson distribution approximately with an average rate of 10 per 8-hour day, what is the mechanic's expected idle time each day? How many jobs are ahead of the average set just brought in? **[05]**

Q2.

(a) Use Simplex method to solve following LPP **[10]**

$$Maximize\ z = 3x_1 + 5x_2 + 4x_3$$

$$Subject\ to\ constraints:\ 2x_1 + 3x_2 \leq 8$$

$$2x_2 + 5x_3 \leq 10$$

$$3x_1 + 2x_2 + 4x_3 \leq 15$$

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

(b) Workers come to tool store room to receive special tools (required by them) for accomplishing a particular project assigned to them. The average time between two arrivals 60 seconds and the arrival are assumed to be in Poisson distribution. The average service time (of tool room attendant) is 40 seconds. Determine **[10]**

1) Average queue length
2) Average length of non-empty queue
3) Average number of workers in system
4) Mean waiting time of an arrival
5) Average waiting time of an arrival (worker) who waits.

Q3.

(a) A particular item has a demand of 9000 units/year. The cost of one procurement is INR100/ and the holding cost per unit is INR 2.40 per year. The replacement is instantaneous and no shortages are allowed. Determine **[10]**

1) the economic lot size
2) the number of orders per year,
3) the time between orders,
4) the total cost per year if the cost of one unit is INR 1.

(b) Determine an initial basic feasible solution to the following Transportation Problem using North West Corner Method (NWCM). Also find the optimal transportation plan. **[10]**

Source	D	E	F	G	Supply
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

Q4.

(a) (i) Explain the principle of dominance and saddle point. **[05]**

(ii) Solve the game whose payoff matrix is given below: **[05]**

Player B

Player A \ no.	I	II	III	IV
I	3	2	4	0
II	3	4	2	4
III	4	2	4	0
IV	0	4	0	8

(b) Use Dual Simplex method to solve the following LPP **[10]**

$$Minimize\ z = 2x_1 + 2x_2 + 4x_3$$

$$Subject\ to\ constraints:\ 2x_1 + 3x_2 + 5x_3 \geq 2$$

$$3x_1 + x_2 + 7x_3 \leq 3$$

$$x_1 + 4x_2 + 6x_3 \leq 5$$

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

Q5.

(a) Use Big-M method to solve the below LPP: **[10]**

$$Minimize\ z = 600x_1 + 500x_2$$

$$Subject\ to:\ 2x_1 + x_2 \geq 80,$$

$$x_1 + 2x_2 \geq 60,$$

$$x_1\ , x_2 \geq 0$$

(b)A department has five employees with five jobs to be performed. How should the jobs be allocated, one per employees, so as to minimize the total man-hours. The time (in hours) each men will take to perform each job is given in the effectiveness matrix: **[10]**

Employees / Jobs	I	II	III	IV	V
A	10	5	13	15	16
B	3	9	18	13	6
C	10	7	2	2	2
D	7	11	9	7	12
E	7	9	10	4	12

Q6.

(a) Use Dijkstra's algorithm to find the shortest path from city A to city D in the following network: **[10]**

From City	*To City*	*Distance in km*
A	B	05
A	C	20
A	E	05
B	C	12
B	E	03
D	B	04
D	E	06
E	C	02

(b) There are five jobs, each of which is to be processed through three machines A, B and C in the order ABC. Processing time in hours are given below. Determine the optimum sequence for the five jobs and the minimum elapsed time. Also find the idle time for three machines and waiting time for the jobs. **[10]**

Job	A	B	C
1	3	4	7
2	8	5	9
3	7	1	5
4	5	2	6
5	4	3	10