Q.P. Code: 27568

Duration: 3 Hours **Total Marks: 80**

N. B.

1. Question Number **ONE** is compulsory.
2. Attempt any **THREE** questions from remaining **FIVE** questions.
3. Assume suitable data if necessary.

Q.1. Attempt any four questions from the followings **20**

a Construct Dual for a given Primal **5**

Maximize $Z=2X_1 + 1X_2 + 5X_3$

Subject to

$2X_1 + X_2 + 4X_3 \geq 2$

$X_1 - X_2 + 2X_3 \geq 0$

$X_1 - 2X_3 \leq 3$

$X_1 + X_2 + X_3 = 0$

$X_1, X_2 \geq 0$. X_3 unrestricted in sign.

b Explain KENDALL'S NOTATION for representing Queuing Models. **5**

c Explain various types of FLOATS used in project Scheduling. **5**

d Write short note on Replacement Theory. **5**

e Use the method of matrices to solve the following game. **5**

$$\begin{bmatrix} 7 & 1 & 7 \\ 9 & -1 & 1 \\ 5 & 7 & 6 \end{bmatrix}$$

Q.2. a A company has two assembly lines to produce its products. The processing time for each of the assembly lines is regarded as a random variable and is described by the following probabilities. **10**

Processing Time (Min.)	Assembly X	Assembly Y
40	0.10	0.20
42	0.15	0.40
44	0.40	0.20
46	0.10	0.15
48	0.25	0.05

Using the following random numbers, generate data on the processing times for 10 units of the items and compute the expected processing time for the product. Random Numbers: 4236, 7573, 4943, 1283, 2014, 3604, 9344, 5316, 7606, 0089. Take the first two digits for the processing time for assembly X and last two digits for the processing time for assembly Y.

b. A firm owns facilities at six places. It has manufacturing plants at places A, B and C with daily production of 50, 40 and 60 units respectively. At points D, E and F it has three warehouses with daily demands of 20, 95 and 35 units respectively. Per unit shipping costs are given in the following table. If the firm wants to minimize its total transportation cost, how should it rout its products? (Use North-west corner rule method for initial feasible solution. **10**

		Warehouse		
		D	E	F
Plant	A	6	4	1
	B	3	8	7
	C	4	4	2

Q.3. a. Convert the following LPP in to canonical form. **10**

Minimize $Z=2X_1 + X_2 + 4X_3$

Subject to

$-2X_1 + 4X_2 \leq 4$

$X_1 + 2X_2 + X_3 \geq 5$

$2X_1 + 3X_2 = 2$

$X_1, X_2 \geq 0$ and X_3 unrestricted in sign.

b. Solve the given assignment problem. Given is the cost matrix. **10**

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

Q.4. a. Use Dual Simplex Method to solve the following LPP. **10**

Maximize $Z = -3X_1 - 2X_2$

Subject to

$X_1 + X_2 \geq 1$

$X_1 + X_2 \leq 7$

$X_1 + 2X_2 \geq 10$

$X_2 \leq 3$

$X_1, X_2 \geq 0.$

b. A self-service store employs one cashier at its counter. Nine costumers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson's distribution for arrival rate and exponential distribution for service time, find **10**

i. Average time a customer spends in the system.
ii. Average time a customer waits before being served.
iii. Probability that the queuing system is idle.
iv. Probability of at most 5 customers arrivals in 4min

Q.5. a. Find the shortest route from city 1 to city 10 by using Dynamic Programming technique. Distances are given in kilometers. **10**

Arc	Dist. (km)	Arc	Dist. (km)	Arc	Dist. (km)	Arc	Dist. (km)
1-2	5	2-7	8	4-6	5	6-9	7
1-3	5	3-5	8	4-7	7	7-8	5
1-4	6	3-6	10	5-8	6	7-9	7
2-5	4	3-7	5	5-9	8	8-10	8
2-6	7	4-5	4	6-8	9	9-10	9

b Ashok chemicals company manufactures two chemicals A and B which are sold to the manufacturers of soaps and detergents. On the basis of the next month's demand, the management has decided that the total production for chemicals A and B should be at least 350 kilograms. Moreover, a major customer's order for 125 kg of product A must also be supplied. Product A requires 2 hrs of processing time per kg and product B requires 1 hr of processing time per kg. For the coming month 600 hrs of processing time is available. **10**

The company wants to meet the above requirements at minimum total production cost. The production costs are Rs. 2 per kg for product A and Rs. 3 per kg for product B.

Ashok chemicals company wants to determine its optimal product mix and the total minimal cost relevant thereto.

Formulate the above as the Linear Programming Problem.

Q.6 a Draw the network and find the critical path of the given project. Also find the project duration. Find the probabilities of the project duration meeting a target date of 55 days. What is the variance and standard deviation of the project length? **10**

Job	Predecessor	Time		
		O	M	P
A	--	4	6	8
B	A	5	7	15
C	A	4	8	12
D	B	15	20	25
E	B	10	18	26
F	C	8	9	16
G	E	4	8	12
H	D,F	1	2	3
I	G,H	6	7	8

Q.6 b A Market research company has been commissioned by a food manufacturer to carry out research about market in a new product development, prior to a test market launch. The table below lists required activities and their durations, in weeks: **10**

(i) Draw the new product development network. State and explain the critical path, and its duration.

(ii) Prepare a table of the earliest start and finish times, the latest start and finish times, and the total float.

Activity	Predecessor	Duration
A	-	7
B	-	2
C	B	4
D	A,B	6
E	A,B	7
F	B	3
G	E,D,F	9
H	D,E	4
I	E,F	5
J	H,G,I,C	4