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**Duration: 3hrs**           **[Max Marks:80]**

N.B. :
(1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

**Q1**    Attempt any **FOUR**.        **[20]**

a   Explain the terms: (i) inventory carrying cost, (ii) optimal order quantity, (iii) reorder point.

b   Discuss types of simulation models. What are the advantages and limitations of simulation models?

c   Write short note on feasibility solution in LP model.

d   Explain the difference between assignment and transportation models.

e   Write a short note on Game theory.

f   Explain the concept of dynamic programming and the relation between 'dynamic' and 'linear' programming problems.

**Q.2**   a   Solve the following L.P.P. using the simplex method      **[10]**

Maximize $z = 2x_1 + 5x_2$

Subject to: $x_1 + 4x_2 \leq 24$

$3x_1 + x_2 \leq 21$

$x_1 + x_2 \leq 9$

$x_1, x_2 \geq 0$

b   Explain the principle of dominance and hence solve the following game:      **[10]**

|  |  | Player B |  |  |
|---|---|---|---|---|
|  |  | 1 | 2 | 3 |
| Player A | I | 8 | 5 | 8 |
|  | II | 8 | 6 | 5 |
|  | III | 7 | 4 | 5 |
|  | IV | 6 | 5 | 6 |

**Q.3**   a   Find the basic feasible solution of the following transportation problem by North-west Corner Rule. Also find the optimal transportation plan.      **[10]**

|  | 1 | 2 | 3 | 4 | 5 | Available |
|---|---|---|---|---|---|---|
| A | 7 | 6 | 4 | 5 | 9 | 40 |
| B | 8 | 5 | 6 | 7 | 8 | 30 |
| C | 6 | 8 | 9 | 6 | 5 | 20 |
| D | 5 | 7 | 7 | 8 | 6 | 10 |
| Required | 30 | 30 | 15 | 20 | 5 | 100(Total) |

b   A particular item has a demand of 8,000 units/year. The cost of one procurement is Rs.150 and the holding cost per unit is Rs.2.6 per year. The replacement is instantaneous and no shortages are allowed. Determine-      **[10]**

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(i) The economic lot size, $q_0$
(ii) The number of orders per year, $n_0$
(iii) The time between orders, $t_0$
(iv) The total cost per year if the cost of one unit is Rs. 1.5.

Q.4　a　A machine shop supervisor has four machines and four tasks for completion. Each　[10]
of the machines can perform each of the four tasks. Time taken at each of the
machines to complete the tasks is given in the matrix below-

| Tasks | Machines | | | |
|---|---|---|---|---|
| | M1 | M2 | M3 | M4 |
| 1 | 31 | 62 | 29 | 42 |
| 2 | 12 | 19 | 39 | 55 |
| 3 | 17 | 29 | 50 | 41 |
| 4 | 35 | 40 | 38 | 42 |

How should the tasks be assigned to minimize total time required for processing?

b　At a booking window customers arrive at the rate of 10 per minute approximated)　[10]
to Poison's distribution. If service time is exponentially distributed with a mean of
15 per minute, determine-
(a) Probability that the booking clerk waits for the customer,
(b) Probability that there are at least 3 customers in the queue,
(c) Average number of customers in system,
(d) Average time spent in the queue,
(e) Probability that the customer is served within four minutes.

Q.5　a　Solve the following L.P.P. by Big-M method-　[10]

Maximize $z = 12x_1 + 20x_2$
Subject to : $6x_1 + 8x_2 \geq 100$
$7x_1 + 12x_2 \geq 120$
$x_1, x_2 \geq 0$

b　A company manufactures around 200mopeds. Depending upon the availability　[10]
of raw materials and other conditions, the daily production has been varying
from 196 mopeds to 204 mopeds; whose probability distribution is as given
below-

| Production /day | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 |
|---|---|---|---|---|---|---|---|---|---|
| Probability | 0.05 | 0.09 | 0.12 | 0.14 | 0.20 | 0.15 | 0.11 | 0.08 | 0.06 |

The finished mopeds are transported in a specially designed three-storeyed lorry
that can accommodate only 200 mopeds. Using the following 15 random
numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54 and 10, simulate the
process to find out-
(i) What will be the average number of mopeds waiting in the factory?
(ii) What will be the number of empty spaces in the lorry?

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Q.6 a  A firm has divided its marketing area into three zones. The amount of sales [10] depends upon the number of salesmen in each zone. The firm has been collecting the data regarding sales and salesmen in each area over a number of past years. The information is summarized in table below. For the next year firm has only 9 salesmen and the problem is to allocate these salesmen to three different zones so that the total sales are maximum.

| Number of salesmen | Profits in thousands of rupees | | |
| --- | --- | --- | --- |
| | Zone 1 | Zone 2 | Zone 3 |
| 0 | 30 | 35 | 42 |
| 1 | 45 | 45 | 54 |
| 2 | 60 | 52 | 60 |
| 3 | 70 | 64 | 70 |
| 4 | 79 | 72 | 82 |
| 5 | 90 | 82 | 95 |
| 6 | 98 | 93 | 102 |
| 7 | 105 | 98 | 110 |
| 8 | 100 | 100 | 110 |
| 9 | 90 | 100 | 110 |

b  Solve the following L.P.P. by Two-phase method- [10]
Minimize $z = 5x_1 - 4x_2 + 3x_3$
Subject to : $2x_1 + x_2 - 6x_3 = 20$
$6x_1 + 5x_2 + 10x_3 \leq 76$
$8x_1 - 3x_2 + 6x_3 \leq 50$
$x_1, x_2, x_3 \geq 0$

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$= 5x_1 - 4x_2 + 3x_3 + 0s_1 + 0s_2 + 0s_3 - M.$