

SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN  
(AUTONOMOUS)

(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)

Chromepet, Chennai - 600 044.

M.Sc.Applicable Mathematics - END SEMESTER EXAMINATIONS - APRIL 2025

SEMESTER - IV

**24PAMET4A05 - Operations Research**

Total Duration : 2 Hrs. 30 Mins.

Total Marks : 60

**Section B**

Answer any **SIX** questions ( $6 \times 5 = 30$  Marks)

1. Write the dual of the following primal LP problems

$$\text{Max } Z_x = 2x_1 + 5x_2 + 6x_3$$

Subject to (i)  $5x_1 + 6x_2 - x_3 \leq 3$ .

$$(ii) -2x_1 + x_2 + 4x_3 \leq 4.$$

$$(iii) x_1 - 5x_2 + 3x_3 \leq 1.$$

$$(iv) -3x_1 - 3x_2 + 7x_3 \leq 6. \text{ and } x_1, x_2, x_3 \geq 0.$$

2. Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order *ABC*. Processing times (in hours) are given in the following table:

Job :	1	2	3	4	5
<b>Machine A</b>	8	10	6	7	11
<b>Machine B</b>	5	6	2	3	4
<b>Machine C</b>	4	9	8	6	5

3. Explain the meaning of Inventory Control.
4. The cost of fuel for running a train is proportional to the cube of the speed generated in km per hour. When the speed is 12 km per hour, the cost of fuel is Rs 64 per hour. If other charges are fixed, namely Rs 2,000 per hour, find the most economical speed of the train for running a distance of 100 km.

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5. A manufacturing company processes 6 different jobs on two machines *A* and *B*. Number of units of each job and its processing times on *A* and *B* are given below. Find the optimal sequence, the total minimum elapsed time and idle time for either machine.

Job Number	Number of Units of Each Job	Processing Time (in Minutes)	
		Machine A	Machine B
1	3	5	8
2	4	16	7
3	2	6	11
4	5	3	5
5	2	9	7.5
6	3	6	14

6. A commodity is to be supplied at a constant rate of 25 units per day. A penalty cost will be charged at a rate of Rs.10 per unit per day, if it is late for missing the scheduled delivery date. The cost of carrying the commodity in inventory is Rs.16 per unit per month. The production process is such that each month (30 days) a batch of items is started and is available for delivery any time after the end of the month. Find the optimal level of inventory at the beginning of each month.
7. Graphically solve the following NLP problem  
 Maximize  $Z = 8x_1 - x_1^2 + 8x_2 - x_2^2$   
 subject to the constraints  
 (i)  $x_1 + x_2 \leq 12$   
 (ii)  $x_1 - x_2 \geq 4$  and  $x_1, x_2 \geq 0$
8. The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs.36 and the cost of carrying inventory is 25 per cent of the investment in the inventories. The price is Rs.10 per kg. Help the purchase manager to determine an ordering policy for raw material.

### Section C

I - Answer any **TWO** questions ( $2 \times 10 = 20$  Marks)

9. Solve the following sequencing problem, giving an optimal solution when passing is not allowed

Machine	Job				
	A	B	C	D	E
$M_1$	11	13	9	16	17
$M_2$	4	3	5	2	6
$M_3$	6	7	5	8	4
$M_4$	15	8	13	9	11

Contd...

10. Each unit of an item costs a company Rs.40. Annual holding costs are 18 per cent of unit cost of the item due to miscellaneous changes: 1 per cent for insurance, 2 per cent allowances for obsolescence, Rs.2 for building overheads, Rs.1.50 for damage and loss, and Rs.4 miscellaneous costs. The annual demand for the item is constant at 1,000 units. Placing each order costs the company Rs.100.
- (a) Calculate EOQ and the total costs associated with stocking the item.
- (b) If the supplier of the item will only deliver batches of 250 units, how are the stock holding costs affected?
- (c) If the supplier relaxes his order size requirement, but the company has limited warehouse space and can stock a maximum of 100 units at any time, what would be the optimal ordering policy and associated costs?
11. Explain the performance measures of a Queuing System.
12. Determine  $x_1$  and  $x_2$  so as to
- Maximize  $Z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$
- Subject to the constraints
- (i)  $x_2 \leq 8$
- (ii)  $x_1 + x_2 \leq 10$  and  $x_1, x_2 \geq 0$ .

II - Compulsory question (1 × 10 = 10 Marks)

13. Use the dual simplex method to solve the following LP problem
- Max  $Z = -2x_1 - x_3$
- Subject to the constraints
- (i)  $x_1 + x_2 - x_3 \geq 5$
- (ii)  $x_1 - 2x_2 + 4x_3 \geq 8$  and  $x_1, x_2, x_3 \geq 0$ .

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