and x_1 , x_2 , $x_3 \geq 0$

(b) Write a note on contrained geometric programming. 4

8. (a) Use separable programming to solve the following problem. 9

Max $z = x_1 + x_2^4$ subject to the constraints

$$3x_1 + 2x_2^2 \leq 9 \ , \quad x_1 \geq 0 \ , \ x_2 \geq 0$$

(b) What do you mean by separable non-linear programming problem? How will you solve the separable non-linear programming problem:

$$\text{Min } z = \sum_{j=1}^{n} f_{oj}\ (x_j) \quad \text{subject to}$$

2+3=5

$$\sum_{j=1}^{n} f_{oj}\ (x_j) \geq b_j \ , \quad j = 1, 2, \ldots \text{r}$$

Unit - V

9. (a) Using dynamic programming find 9

Min $z = x_1 + x_2 + \ldots . + x_n$

when x_1 , x_2 , ... $x_n = \text{d}$ and, x_1 , x_2 , ... $x_n \geq 0$

(b) Write a note on dynamic programming. 5

10. (a) Solve the following linear fractional programming problem 9

$$\text{Max } z = \frac{2x_1 + 3x_2}{x_1 + x_2 + 7} \quad \text{subject to the}$$

constraints $3x_1 + 5x_2 \leq 15$, $4x_1 + 3x_2 \leq 12$
and x_1 , $x_2 \geq 0$

(b) State and explain Bellman's principle of optimality in dynamic programming. 5

★★★

PG (CBCS) Even Semester Examination, May 2025

MATHEMATICS

4th Semester

Course No. : MTMCC - 404 (g)

(Operation Research-III)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(All the symbols have their usual meanings)

(Answer one question from each unit)

Unit - I

1. (a) Write a short note on application of Goal Programming: 6

(b) Solve the following goal programming problem using graphical method. 8

Min $z = p_1 d_1^- + P_2\ (2d_2^- + d_3^-\ ) + P_3 d_1^+$
subject to

$$x_1 + x_2 + d_1^- - d_1^+ = 10$$
$$x_1 + d_2^- = 6$$
$$x_2 + d_3^- = 8$$

and x_1 , x_2 , d_1^- , $d_1^+ \cdot d_2^- \cdot d_3^- \geq 0$

2. (a) Explain the main features of linear goal programming 5

(b) Solve by modified simpelx method 9

Min $z = (\ 3d_1^+ + 2d_2^+ \cdot d_3^- \cdot d_4^-\ )$

(Turn Over)

subject to

$$x_1 + d_2^- - d_2^+ = 3,\ \ 3x_1 + 5x_2 + d_3^- - d_3^+ = 65$$
$$x_1 + x_2 + d_4^- - d_4^+ = 65 \ \text{and}$$
$$x_1, x_2, d_1^+, d_2^-, d_2^+, d_3^+, d_4^-, d_4^+ \geq 0$$

Unit - II

3. (a) The cost of a machine is Rs. 6100/- and its scrap value is only Rs. 100/-. The maintenance costs are found from experience to be as below - 6

Years	1	2	3	4	5	6	7	8
Maintenance	100	250	400	600	900	1250	1600	2000

when should the machine be replaced.

(b) the cost of new car is Rs. 10,000/-. Compare the optimum moment of replacement assuming the following cost informations 8

Age of car	Repair cost in n^{th} year	Solvage value at the end of the n^{th} year
1	5000/-	8000/-
2	10000/-	6400/-
3	10000/-	5120/-

Assume that repairs are made at the end of each year only if the car is to be retained and are not necessary if the car to be sold for its solvage value. Also assume that the rate of discount is 10%.

4. (a) What is replacement? Describe some important replacement situations and policies. 2+4=6

(b) The following mortality rates have been found for a certain type of coal cutter motor. 8

Weeks	10	20	30	40	50
Total percentage failure upto the end of 10 week period	5	15	35	65	100

If the motors are replaced over the weekend the total cost is Rs. 20/-. If they fail during the week the total cost is Rs. 100/- per failure. Is it better to replace the motors failure and if so when?

Unit - III

5. (a) What is decision tree? Explain the steps invovled in information of decision tree. 2+5=7

(b) A retailer purchases cherries every morning at Rs. 50/- a case and sells then far Rs. 80/- a case. Any case remaining unsold at the end of the day can be disposed of next day at a solvage value of Rs. 20/- per case (thereafter they have no value). Past sales have ranged from 15 to 18 cases per day. The following is the record of sales for the past 120 days:

Cases sold	15	16	17	18
Number of days	12	24	48	36

Find how many cases the retailer should purchase per day to maximize the profit. 7

6. (a) What is decision theory? Discuss the different types of decision making environments. 2+5=7

(b) A manager of a Flower-stop promises its customers delivery within four hours on all flower orders. All flowers are purchased on the provious day and delivered to the customer X by 8:00 am, the next morning. The daily demand for roses is as follows :

Dozens of roses	70	80	90	100
Probability	0.1	0.2	0.4	0.3

The manager purchases roses for Rs. 10/- per dozen and sells them for Rs. 30/-. Al unsold roses are denoted to a local hospital. How many dozens of roses should the customer X order each evening to maximize its profit. What is the optimum expected profit? 7

Unit - IV

7. (a) Solve the following geometric programming problem: 10

$$\text{Min } f(x) = 40x_1^{-1} x_2^{-1} x_3^{-1} + 40\, x_2 x_3 + 20\, x_1 x_2 + 10\, x_1 x_3$$