[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 2333-A **GC-3** **Your Roll No.....**

Unique Paper Code : 62364345

Name of the Paper : Optimization Techniques

Name of the Course : **B.A. Programme – Operational Research (CBCS)**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on the receipt of this question paper.
2. Attempt any **Five** questions.
3. **All** questions carry equal marks.

1. (a) Define a non-linear programming problem (NLPP). Write its applications with suitable examples. (7)

   (b) Use dynamic programming to solve the following linear programming problem (LPP) :

   Maximize $Z = 3x_1 + 5x_2$

   Subject to $x_1 \leq 4$

   $x_2 \leq 6$

   $3x_1 + 2x_2 \leq 18$

   $x_1, x_2 \geq 0$ (8)

P.T.O.

2. (a) Use the method of Lagrange multiplier to solve the following NLPP

$$\text{Max } Z = -x_1^2 - x_2^2 + 6x_1 + 8x_2$$

Subject to $4x_1 + 3x_2 = 16$

$3x_1 + 5x_2 = 15$

$x_1, x_2 \geq 0$ (7)

(b) Construct the objective function for the following goal programming problem and then solve it graphically

$x_1 + x_2 \leq 80$

$x_1 \leq 70$

$x_1 \leq 45$

$x_1 + x_2 \geq 90$

$x_1, x_2 \geq 0$ (8)

3. Define a quadratic programming problem (QPP). Solve the following QPP using Wolfe's method

Maximize $f(X) = 2x_1 + x_2 - x_1^2$

Subject to $2x_1 + 3x_2 \leq 6$

$2x_1 + x_2 \leq 4$

$x_1, x_2 \geq 0$ (15)

4. (a) Define a convex function and prove that a linear combination of convex function is convex. (6)

(b) Using the Kuhn-Tucker conditions to solve the following NLPP :

Minimize $Z = 2x_1 - x_1^2 + 3x_2 - 2x_2^2$

Subject to $x_1 + 3x_2 \leq 6$

$5x_1 + 2x_2 \leq 10$

$x_1, x_2 \geq 0$ (9)

5. (a) Use Beale's method to solve the following QPP :

Maximize $f(X) = 2x_1 - x_1^2 + 3x_2$

Subject to $x_1 + 2x_2 \leq 4$

$x_1, x_2 \geq 0$ (9)

(b) What is a dynamic programming problem ? How it is different from a LPP ? (6)

6. (a) State Bellman's principle for optimality. Solve the following problem using dynamic programming

Minimize $Z = x_1^2 + x_2^2 + x_3^2$

Subject to $x_1 + x_2 + x_3 \leq 15$

$x_1, x_2, x_3 \geq 0$ (1+6)

(b) A truck can carry 20 tons of load. Four types of products are to be loaded. Their per unit weight in tons and values in thousands of rupees are given below :

Type	Weight/unit	Value/unit
A	1	20
B	2	30
C	3	50
D	4	85

At least one unit of each type of load is to be shipped. Determine the loading which will maximize the value of the load. (8)

7. (a) The NW shopping mall conducts special events to attract potential patrons. Among the events that seem to attract teenagers, the young/middle aged group and senior citizens, the most popular are band concerts and art shows. Their costs per presentation are Rs. 1500 and Rs. 3000, respectively. The total (strict) annual budget allocated to the two events is Rs. 15,000. The mall manager estimates the attendance as follows :

	Number attending per presentation		
Event	Teenagers	Young/middle age	Senior citizens
Band Concert	200	100	0
Art show	0	400	250

The mall manager has set minimum goal of 1000, 1200 and 800 for the attendance of teenagers, the young/middle aged group and senior citizens, respectively. Formulate the problem as a goal programming problem. (10)

(b) Differentiate between goal programming and linear programming approach. (5)

(100)