[This question paper contains 4 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 6343** **G**

Unique Paper Code : 62364345

Name of the Paper : Optimization Techniques (DSE)

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

Semester : V

Duration : 3 Hours Maximum Marks : 75

**Instructions for Candidates**

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

1. (a) Define convex and concave functions mathematically and geometrically with examples. Provide a function that is both convex and concave. Finally, offer examples of functions that are neither convex nor concave. (7)

P.T.O.

(b) Solve the following Non-Linear programming problem. (8)

$$\max f = 3x_1^2 + 2x_2^2$$

Subject to $x_1^2 + x_2^2 \leq 9$

$$x_1 + x_2 \leq 3$$

2. (a) What is goal programming? State clearly, it's assumptions. (7)

(b) Check the weather giving function are convex function or concave function. (8)

$$f(x) = -2x^2 + 3x + 4$$

$$x_1, x_2 \geq 0$$

3. (a) Explain separable programming problem. (7)

(b) Solve the following problem. (8)

$$\text{Min } f(x_1, x_2) = x_1 + x_2 + + \frac{1}{x_1 x_2}$$

$$x_1, x_2 \geq 0$$

4. (a) Let f be a convex function on a convex set $S \subset R^n$ then every local minimum is also a globle minimum and f is strictly convex if it is unique. (7)

(b) Find the degree of difficulty for the following function (8)

$$\text{Min } f(x) = 2x_1x_2 + 2x_1x_2^{-1}x_3 + 4x_1^{-1}x_2^2x_3^{1/2}$$

$$x_1, x_2, x_3 \geq 0$$

5. (a) What is dynamic programming problem? How it is different from a LPP? (7)

(b) Create a Linear Programming problem for the following Non-linear programming problem using KKT conditions. (8)

$$\text{Min } f(x) = x_1^2 + x_2^2 - 10x_1 - 10x_2$$

$$\text{Subject to } -x_1 + x_2 - 14 \leq 0$$

$$-x_1 + x_2 - 6 \leq 0$$

$$x_1, x_2 \geq 0$$

6. (a) Write a short note on Non-Linear programming problem. (7)

(b) Use Beale's method to solve the following QPP : (8)

$$\text{Max } f(x) = 2x_1 - x_1^2 + 3x_2$$

$$\text{Subject to } x_1 + 2x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

7. (a) A firm produces two products A and B. Each product must be processed through two departments namely 1 and 2. Department 1 has 30 hours of production capacity per day, and department 2 has 60 hours. Each unit of product A requires 2 hours in department 1 and 6 hours in department 2. Each unit of product B requires 3 hours in department 1 and 4 hours in department 2. Management has rank ordered the following goals it would like to achieve in determining the daily product mix :

P1 : Minimize the underachievement of joint total production of 10 units.

P2 : Minimize the underachievement of producing 7 units of product B.

P3 : Minimize the underachievement of producing 8 units of product A.

Formulate this problem as a GP model and then solve it by using the graphical method. (7)

(b) State Bellman's principal for optimality. Solve the following problem using dynamic programming

Min $f(x) = x_1^2 + x_2^2 + x_3^2$

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

$x_1, x_2 \geq 0$ (8)