

Roll Number: _____

All questions are compulsory. There are 9 questions. A scientific calculator is allowed.
Make appropriate assumptions wherever necessary.

1. Apply the Fibonacci Search Method to determine the point at which the given function attains its minimum over the specified interval.

$$f(x) = x^2 + 2x$$

Consider the search interval $[-3, 4]$ and use $n = 6$ for the Fibonacci iterations.

(4 - COs 3)

2. Use the *Steepest Descent Method* to minimize the function

$$f(x_1, x_2) = x_1^2 - x_1x_2 + x_2^2$$

starting from the initial point

$$X_1 = \begin{pmatrix} 1 \\ \frac{1}{2} \end{pmatrix}.$$

Perform the iterations until the stopping condition

$$|f(X_{k+1}) - f(X_k)| < 0.05$$

is satisfied.

(3 - COs 3)

3. Determine the minimum of the quadratic function using the Conjugate Gradient Method.

$$f(x_1, x_2) = 3x_1^2 - 4x_1x_2 + 2x_2^2 + 4x_1 + 6,$$

where $(x_1, x_2) \in R^2$.

(3 - COs 3)

4. Apply a suitable recursive optimization method to solve the following nonlinear problem.

$$\text{Minimize } z = x_1^2 + x_2^2 + x_3^2$$

subject to

$$x_1 + x_2 + x_3 = 15,$$

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

(3 - COs 4)

5. Reduce the interval of uncertainty using golden-ratio proportions to determine where the function attains its minimum:

$$f(x) = 4x^3 + x^2 - 7x + 14,$$

over the interval $[0, 1]$ with a stopping tolerance of $\epsilon = 0.15$.

(3 - COs 3)

6. Use Newton's method to find the minimum of the function

$$f(x_1, x_2) = 8x_1^2 + 4x_1x_2 + 5x_2^2,$$

starting from the initial point $X_1 = \begin{pmatrix} 10 \\ 10 \end{pmatrix}$. Perform the required iteration(s) and compute the next approximation X_2 .

(4 - COs 3)

7. Solve the given optimization problem using the K.K.T. conditions to find the minimum point.

$$\text{Minimize } f(x) = x_1^2 - 4x_1 + x_2^2 - 6x_2$$

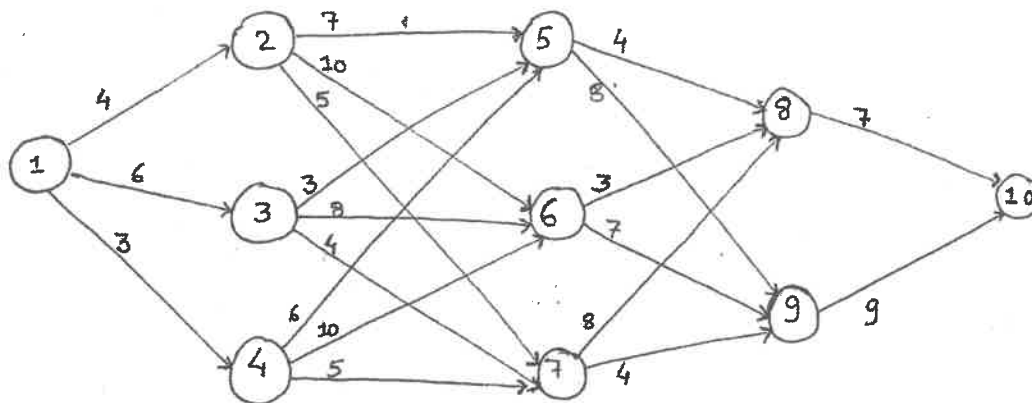
subject to

$$\begin{aligned} x_1 + x_2 &\leq 3, \\ -2x_1 + x_2 &\leq 3, \\ x_1 &\geq 0, \\ x_2 &\geq 0. \end{aligned}$$

(3 - COs 2)

8. Using the Dynamic Programming approach, determine the minimum-cost path from node 1 to node 10 in the given network.

(3 - COs 4)



9. Use a Genetic Algorithm to maximize the function

$$f(x) = x^2,$$

where the variable $0 \leq x \leq 31$. Show one full iteration of the Genetic Algorithm.

(4 - COs 5)

