COURSE NAME: B. TECH

SEMESTER:8th

BRANCH NAME: CHEMICAL ENGINEERING

FULL MARKS:**70**

TIME:**3 Hours**

SUBJECT NAME: OPTIMIZATION TECHNIQUES IN PROCESS DESIGN (OTPD)

Answer **All**Questions.

The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*

Q1. Answer all Questions. **[1×5]**

a) What is the difference between local minimum and global minimum?

b) Determine the stationary points of the following function

$f(x) = 3x^4 - 4x^3 - 4x^2 + 48x + 15$

c) What is Fibonacci series?

d) What is point ofinflection?

e) How the value of golden ratio γ isdetermined?

f) Write down the KKT Conditions for solving nonlinear Programming problems of inequality constraint.

g) What is the difference between usable and feasibledirection.

h) Write down the formula for ProjectionMatrix.

i) Write down the expressions for Search directions (S_i) for equality constraint and for inequality constraint

j) What is difference between feasible solution and Infeasible solution?

Q2.

Minimize the function $f(x) = 4x^3 + x^2 - 7x + 14$ within the interval [0,1] using Golden section search method. Stopping tolerance of the iteration process is $\varepsilon = 0.15$. **[10]**

OR

Minimize the function $f(X_1, X_2) = 2(X_1)^2 + 2X_1X_2 + (X_2)^2 + X_1 - X_2$ byusing Cauchy's Steepest descentmethod. **[10]**

Q3.

Find the minimum of the function $f(X) = X^3 - 6X^2 + 4X + 12$ where $X \in [-2,6]$ by using Bisection method. Achieve the accuracy within 5% of exact value. **[10]**

OR

Find the dimensions of a rectangular prism-type box that has the largest volume when the sum of its length, width, and height is limited to a maximum value of 60 in. andits length is restricted to a maximum value of 36 in. **[10]**

Q4.

Minimize the function $f(X_1,X_2) = X_1^2 + X_2^2 - 4X_1 - 4X_2 + 8$ subjectto $g_1(X_1, X_2) = X_1 + 2X_2 - 4 \leq 0$ [10]

$$X_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}.$$

with the starting point

Take $\varepsilon 1 = 0.001$, $\varepsilon 2 = 0.001$, and $\varepsilon 3 = 0.01$. Solve this problem by ZOUTENDIJK'S Method of feasible direction.

OR

Minimize the function $2x^2 - 24x + 2y^2 - 8y + 2z^2 - 12z + 200$ subject to $x + y + z = 1$ [10]

Q5.

Find the minimum of the function : [10]

$f(X) = 0.65 - 0.75/(1+X^2) - 0.65X\tan^{-1}(1/X)$ using Newton – Raphson method with starting point $X_1=0.1$ and use tolerance limit $\varepsilon = 0.01$ for convergence.

OR

Minimize the function $f(X_1,X_2) = X_1^2 + X_2^2 - 2X_1 - 4X_2$ [10]

Subject to $g_1(X_1, X_2) = X_1 + 4X_2 - 5 \leq 0$

$g_2(X_1, X_2) = 2X_1 + 3X_2 - 6 \leq 0$

$g_3(X_1, X_2) = -X_1 \leq 0$

$g_4(X_1, X_2) = -X_2 \leq 0$

starting from the point $X_1 = \{ 1, 1 \}$

By ROSENMUND method.

Q6.

[10]

It has been decided to shift grain from a warehouse to a factory in an open rectangular box of length x_1 meters, width x_2 meters, and height x_3 meters. The bottom, sides, and the ends of the box cost, respectively, \$80, \$10, and \$20/m^2. It costs \$1 for each round trip of the box. Assuming that the box will have no salvage value, find the minimum cost of transporting 80m^3 of grain.

OR

[10]

Minimize the function $f(x) = x(x-4)$ where $x \in [0,4]$ given that the function is unimodal .start with initial guess point $x_0 = 1$ and step size $\lambda = 0.2$.