B.TECH
(SEM VIII) THEORY EXAMINATION 2017-18
OPTIMIZATION TECHNIQUES IN CHEMICAL ENGINEERING

Time: 3 Hours   *Total Marks: 100*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.
    2. Any special paper specific instruction.

SECTION A

1.   **Attempt *all* questions in brief.**   **2 x 10 = 20**

  a) Enumerate few engineering applications of optimization.
  b) Define Dichotomous.
  c) Define dynamic programming.
  d) What do you mean by convex function?
  e) Define the saddle point.
  f) What is the significance of Lagrange multipliers?
  g) Discuss about unconstrained optimization problems.
  h) Define artificial variables.
  i) Define duality problem.
  j) What is golden section?

SECTION B

2.   **Attempt any *three* of the following:**   **10 x 3 = 30**

  a) Enumerate the scope and limitations of optimization techniques.
  b) Explain all direct methods for solving LPP.
  c) Describe the Newton's method to find an optimality of a function of one variable.
  d) Find the minimum of $f(x) = x(x-1.5)$ in the interval (0,1) within 10% of the exact value and $\delta = 0.001$.
  e) Describe the gradient method for determining the search direction of first order systems.

SECTION C

3.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

  a) Find the volume of largest rectangular solid inscribed in the ellipsoid.

      $(x^2/a^2) + (y^2/b^2) + (z^2/c^2) = 1$.

  b) Explain the secant method of uni-dimensional search.

4.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

  a) Explain finite difference approximation with example.

  b) The total annual cost of a pump and motor (C) in a particular piece of equipment is a function of x , the size of the motor in horsepower, namely

          $C = \$ 500 + \$ 0.9 x + \$ 0.3 (150000)/x$

      Find the motor size that minimizes the total annual cost.

5.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

(a) Find the minimum of the function

$$F(x) = 0.65 - \frac{0.75}{1+x^2} - 0.65x \tan^{-1}\frac{1}{x}$$

   Using Newton-Raphson method with the starting point $x_1 = 0.1$. Use $\varepsilon = 0.01$ for checking the convergence.

(b) What are the various direct and indirect methods of multivariable search? Discuss any one of them.

6.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

a) Describe the gradient method for determining the search direction of first order systems.

b) Describe Fibonacci search method for a unimodel function of a single variable. Find the maximum and minimum values of the function

$$f(x) = 12x^5 - 45x^4 + 40x^3 + 5.$$

7.   **Attempt any *one* part of the following:**   **10 x 1 = 10**

a) Describe the Optimal solution and optimal basic solution in detail.

b) Solve the following LPP graphically,

   Minimize $f = 3x_1 + x_2$

   Subject to $8x_1 + x_2 \geq 8$

   $2x_1 + x_2 \geq 6$

   $x_1 + 3x_2 \geq 6$

   $x_1 + 6x_2 \geq 8$

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