

(CH505) OPTIMIZATION TECHNIQUES

Objective of the Course :

Students will learn how optimization has been playing a key role in the design, planning and operation of chemical and related processes.

UNIT - I

Introduction to Process Optimization: formulation of various process optimization problems and their classification.

Basic Concepts of Optimization: convex and concave functions, necessary and sufficient conditions for stationary points.

UNIT - II

Optimization of Unconstrained Functions: one-dimensional search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of uni-dimensional search, region elimination methods, polynomial approximation methods.

Unconstrained Multivariable Optimization: Direct methods, random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect methods- first order, gradient method, conjugate method, indirect method- second order: Newton's method.

UNIT - III

Multivariable Optimization Algorithms: Optimality criteria, Unidirectional search, direct search methods: Evolutionary optimization method, simplex search method, Powell's conjugate direction method. Gradient-based methods: Cauchy's (steepest descent) method.

UNIT - IV

Constrained Optimization Algorithms: Kuhn-Tucker conditions, Transformation methods: Penalty function method, method of multipliers, Sensitivity analysis, Successive linear and quadratic programming, optimization of staged and discrete processes.

UNIT - V

Specialized & Non-traditional Algorithms: Integer Programming: Penalty function method, Non-traditional Optimization Algorithms: Genetic Algorithms: Working principles, differences between GAs and traditional methods, similarities between GAs and traditional methods, GAs for constrained optimization, other GA operators, Real-coded GAs, Advanced GAs.

Real Time Optimization: Non linear Optimization and techniques, open loop, closed loop optimization, Gross Error detection, Parameter estimation, objective function Optimization.

TEXT BOOKS:

1. T.F.Edgar and D.M.Himmelblau, "Optimization of Chemical Processes", Mc Graw Hill, International Editions, Chemical Engineering Series, 1989.
2. Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India.

REFERENCE BOOKS :

1. G. S. Beveridge and R. S. Schechter, "Optimization Theory and Practice", Mc Graw Hill, New York, 1970.
2. Reklitis, G.V., Ravindran, A., and Ragdell, K. M., "Engineering Optimization Methods and Applications", John Wiley, New York, 1983.
3. S.S Rao, "Optimization Theory and Applications".