## UCH846: CHEMICAL PROCESS OPTIMIZATION

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 0 | 3.5 |

**Course Objectives:**
To study and apply optimization techniques in the chemical process industry.

**Introduction:** 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.

**Optimization of One Dimensional Functions**: Unconstrained multivariable optimization-direct search methods, Bracketing methods: Exhaustive search, Bounding phase, Region elimination methods- Interval halving, Fibonacci search, Golden section search, Point-Estimation, Successive quadratic estimation methods.

**Indirect First Order and Second Order Methods:** Gradient-based methods-Newton-Raphson, Bisection, Secant, Cubic spline, Root-finding using optimization Techniques.

**Multivariable Optimization Algorithms:** Optimality criteria, Unidirectional search, Direct search Methods- Evolutionary optimization, Simplex search, Powell's conjugate direction, Gradient-based methods- Cauchy's (steepest descent) method, Newton's method.

**Constrained Optimization Algorithms:** Kuhn-Tucker conditions, Transformation methods, Penalty function method, Method of multipliers, Sensitivity analysis, Direct search for constraint Minimization-Variable elimination method, Complex search method, Successive linear and quadratic programming, Optimization of staged and discrete processes.

**Non-traditional Optimization Techniques:** Introduction to Simulated annealing, Genetic algorithms, Differential evolution.

**Course Learning Outcomes (CLO):**

Upon completion of this course, the students will be able to:

1. formulate the objective functions for constrained and unconstrained optimization problems.
2. use different optimization strategies.
3. solve problems using non-traditional optimization techniques.
4. use of different optimization techniques for problem solving.

***Text Books:***


1. *Edgar, T. F., Himmelblau, D. M. and Lasdon, L.S. Optimization of Chemical Processes, McGraw-Hill (2001).*
2. *Babu, B.V., Process Plant Simulation, Oxford University Press (2004).*

***Reference Books:***


1. *Kalyanmoy, D., Optimization for Engineering Design, Prentice Hall (1998).*
2. *Reklaitis, G. V., Ravindran, A., and Ragsdell, K. M., Engineering Optimization - Methods and Applications, John Wiley (1983).*
3. *Pike, R. W., Optimization for Engineering Systems, Van Nostrand Reinhold (1986).*
4. *Box, G. E. P., Hunter, W. G., Hunter, J. S., Statistics for Experimenters - An Introduction to Design, Data Analysis, and Model Building, John Wiley (1978).*


**Evaluation Scheme:**

| S. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May includes tutorials/ assignments/ quiz's etc) | 25 |