Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCHD504	Process Optimization	3	0	0	3

Course Objective
Process optimization introduces basic idea about the minimization/maximization necessary in the field of Chemical Engineering. Students will learn how to formulate an optimization problem and various methods for their solution.
Learning Outcomes
Students will learn the basics of process optimization problem formulation, solution methods for various unconstrained and constrained optimization problems.

Unit No.	Description of Lectures	Lecture Hrs.	Learning Outcomes
1.	Formulation of various process optimization problems and their classification	**3**	Students will learn the basics of process optimization problem formulation
2.	Basic concepts of optimization-convex and concave functions, necessary and sufficient conditions for stationary points	**2**	Students will learn the concept of convex-concave optimization problem formulation
3.	Optimization of one-dimensional functions, bracketing methods: exhaustive search method, bounding phase method, interval halving method	**4**	Students will learn various unconstrained one-dimensional optimization methods
4.	Fibonacci search method, golden section search method, Newton-Raphson method, secant method	**3**	Students will learn various unconstrained one-dimensional optimization methods
5.	Direct methods: random search, grid search, univariate search; Simplex method, conjugate search directions, Powell's method	**5**	Students will learn various unconstrained multi-variable optimization methods
6.	Indirect methods- gradient and conjugate gradient method; Newton's and Quasi-Newton method	**4**	Students will learn various unconstrained multi-variable optimization methods
7.	Basic concepts in linear programming, the simplex method of solving linear programming problems Standard LP form, obtaining a first feasible solution, LP applications	**4**	Students will learn the basics of Linear programming and applications
8.	The Lagrange multiplier method, necessary and sufficient conditions for a local minimum	**3**	Students will learn various methods for nonlinear programming with constraints

9.	Quadratic programming, generalized reduced gradient method Penalty function and augmented Lagrangian methods Successive quadratic programming, NLP applications	**7**	Students will learn various methods for nonlinear programming with constraints
10.	MILP, branch and bound technique, MINLP, outer approximation methods, applications	**3**	Students will learn various Mixed integer programming techniques
11.	Working principles, differences between GAs and traditional methods; similarities between GAs and traditional methods GAs for constrained optimization, other GA operators, real coded GAs, multi-objective GAs, applications	**4**	Students will learn the basics and application of Genetic algorithms
	Total	**42**	

Textbooks:

1. Edgar, T.F. Himmelblau, D.M. (2001) Optimization of Chemical Processes, McGraw-Hill.
2. Rao, S.S. (1996) Engineering Optimization: Theory and Practice, Wiley.
3. Dutta, S. (2016) Optimization in Chemical Engineering, 1st Ed., Cambridge Univ. Press.

Reference Books:

1. Fletcher, R. (2013) Practical Methods of Optimization, Wiley.
2. Floudas, C. A. (1995) Nonlinear and Mixed-Integer Optimization: Fundamentals and Applications, Oxford Univ. Press.