# OPTIMIZATION OF CHEMICAL PROCESSES
## (Professional Elective-VI)

**Course Code: 15CH1143**

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## Course Outcomes :

At the end of the Course, the Student will be able to:

**CO 1** Classify and recognize the optimization problem.

**CO 2** Identify and describe the methods applicable for a particular optimization problem

**CO 3** Relate how unconstrained optimization problem technique can be used to solve a more general constrained optimization problem

**CO 4** Analyze chemical engineering applications such as calculation of optimum reflux ratio and optimum pipe diameter.

**CO 5** Select the best operating variable to optimize any given process

## UNIT-I                                              (10 Lectures)

Gradient of a single variable function, gradient vector of a multi-variable function, second derivative of a single variable function, Hessian of a multi-variable function, Eigen values of a matrix, convex functions, determination of convexity of a function by Eigen values.

Optimality conditions for a single-variable and multi-variable functions, classification of stationary points for single-variable and multi-variable functions.

## UNIT-II                                             (12 Lectures)

Structure of a single-variable and multi-variable optimization problems with and without constraints (qualitative treatment), single-variable optimization methods and problems: interval halving method, golden section method and Fibanocci method.

# UNIT-III                                          (12 Lectures)

Linear programming, Simplex method to solve LP problems, duality principle and converting a LP to dual LP.

# UNIT-IV                                           (9 Lectures)

## MULTI-VARIABLE OPTIMIZATION WITHOUT CONSTRAINTS:

Multi-variable optimization methods, such as steepest descent, Newton's method and unidirectional search method. Solving two-variable optimization problems using above methods.

## MULTI-VARIABLE OPTIMIZATION WITH CONSTRAINTS:

Lagrangian multiplier method, Karush-Kuhn-Tucker (KKT) conditions, penalty function method. Solving two-variable constrained optimization problems using above methods.

# UNIT-V                                            (7 Lectures)

Chemical engineering optimization problems

Part 1: Pipe diameter, multi-stage evaporator, reflux ratio of distillation column.

Chemical engineering optimization problems

Part 2: Thermal cracker, Alkylation reactor.

## TEXT BOOKS:

1.  Edgar, T.F., Himmelblau, D.M. and Lasdon L.S., "Optimization of Chemical Processes", 2nd Edition, McGraw-Hill International, 2001.

2.  Kalyanmoy Deb "Optimization for Engineering Design", Prentice Hall, India, 2005.

3.  Rao S.S., "Engineering Optimization-Theory and Practice", 3 Ed, New Age International Publishers, New Delhi, 1996.

## REFERENCES:

1.  Arora. J.S., "Introduction to Optimum Design", 2nd Edition, Elsevier Academic Press, San Diego, USA, 2004.

2.  Ravindran. A., and Ragsdell, K.M., Reklaitis, G.V., "Engineering Optimization-Methods and Applications", 2nd Edition, Wiley, New York, 2006.