COURSE TITLE	**OPTIMIZATION IN CHEMICAL ENGINEERING**
COURSE CODE	**01CH0709**
COURSE CREDITS	**4**

Objective:

1 The course is intended to identify and develop the optimization techniques for chemical engineering practices

Course Outcomes: After completion of this course, student will be able to:

1 Identify the suitable optimization approach for engineering systems
2 Construct the optimization methodology for different chemical processes
3 Plan the appropriate optimization methodology and execution
4 Test and justify the optimization technique
5 Design the system using optimization techniques and fine tuning of parameters

Pre-requisite of course: Heat Transfer Operation, Mass Transfer Operation, Engineering Mathematics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction** Concept of Optimization, need, Scope and Hierarchy of Optimization, Salient Features, applications, general procedure and Obstacles to Optimization, Developing Models for Optimization, fit empirical data, Degrees of Freedom. Basic concepts: Continuity of Functions, NLP Problem Statement, Convexity and Its Applications	8
2	**Single Variable Unconstrained Optimization Methods** Optimization of Single Variable Function, Direct Search Methods, Direct Root Methods, Polynomial Approximation Methods	10
3	**Multivariable optimization** Multivariable Optimization with No Constraints, Multivariable Optimization with Inequality Constraints , Multivariable Optimization with Constraints: Linear programming concept and simplex method	8

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Contents : Unit	Topics	Contact Hours
4	**Nontraditional and Statistical Optimization** Genetic Algorithm, Particle Swarm Optimization, Differential Evolution, Simulated Annealing, Overview of Ant Colony Optimization, neural network-based optimization and optimization of Fuzzy systems, Design of Experiment, Response Surface Methodology, Overview of Stochastic Optimization, Multi-Objective Optimization and Optimization in Control Engineering	8
5	**Applications in Optimization** Fluid flow operation, Chemical Reactor, Separation processes, Heat Exchanger Network Optimization etc. Introduction and overview of software used in Chemical Industries for the process plant optimization and simulations	6
Total Hours		**40**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To find out optimized values of a given function using graphical method.	2
2	**Experiment 2** To find out optimized values of a given function using excel solver for Single Variable without constraint.	2
3	**Experiment 3** To find out optimized values of a given function using excel solver for Single Variable with constraint.	2
4	**Experiment 4** To find out optimized values of a given function using excel solver for Multi-Variable without constraint	2
5	**Experiment 5** To find out optimized values of a given function using excel solver for Multi-Variable with constraint	2
6	**Experiment 6** To find out optimized values of a given function using excel solver for Linear Programming Problem.	2
7	**Experiment 7** To find out optimized values of a given function using MATLAB toolbox for Linear Programming Problem.	2
8	**Experiment 8** To find out optimized values of a given function using MATLAB toolbox for Non-Linear Programming Problem (NLP).	2
9	**Experiment 9** To determine the optimal operating conditions of a chemical reactor using simulation software	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
10	**Experiment 10** To determination of Optimum Pipe Diameter by Minimizing Annual Cost.	2
11	**Experiment 11** To study the optimization of a heat exchanger network using process simulation software.	2
12	**Experiment 12** To determine the optimal operating conditions of a separation operation using simulation software.	2
13	**Experiment 13** To demonstrate the modern optimization method using MATLAB.	2
Total Hours		**26**

Textbook :

1 Optimization in chemical engineering, Suman Dutta, Cambridge University Press, 2016

2 Optimization for engineering design: Algorithms and examples, Deb, Kalyanmoy, PHI Learning Pvt. Ltd, 2012

References:

1 Engineering Optimization: Theory and Practice, Engineering Optimization: Theory and Practice, Singiresu S. Rao, Wiley India Pvt Ltd, 2009

2 Optimization of Chemical Processes, Optimization of Chemical Processes, Thomas F. Edgar, David. M. Himmelblau, McGraw-Hill Higher Education, 2001

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory

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Instructional Method:

4	Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

1	https://archive.nptel.ac.in/courses/103/105/103105139/

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