Subject Code: 01CH0801
Subject Name: Optimization in Chemical Engineering
B.Tech. Year – IV (Semester VII)

Objective: The course is intended to identify and develop the optimization techniques in engineering practices.

Credits Earned: 4 Credits

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 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

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (I)	CSE (C)	Viva (V)	Term work (TW)	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction to Optimization** Methods of operation research, Scope, Examples of optimization, Features of optimization problems, Optimal design procedure, Optimization algorithms, Classification of optimization problems, Obstacles to optimization	6
2	**Model Development and Formulation** Classification of models, Major activities in model building, Function selection for data fitting, Fitting models by Least Squares, Factorial experimental design, Degrees of Freedom	6

3	**Classical Optimization Techniques** Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with inequality constraints,	8
4	**One-Dimensional Unconstrained Optimization** Golden-section search, Parabolic Interpolation, Newton's Method, Brent's Method	8
5	**Unconstrained Multivariable Optimization** Methods using function values only- Random Search, Grid Search, Univariate Search, Simplex Search Method, Conjugate Search Directions; Methods that use first derivative; Newton's Method; Quasi Newton's Method	8
6	**Application of Optimization** Heat Transfer and Energy Conservation, Separation Processes, Fluid Flow systems, Chemical Reactor Design and Operation, Integrated Planning, Scheduling, and Control in the Process Industries.	6
	Total Hours	**42**

List of Experiments:

1. Analysis of ANOVA function using excel.
2. To find out optimized values of function using excel solver.
3. To find out the lagrange's polynomial for the given data using Matlab.
4. To fit a polynomial curve for the given data.
5. To write a program in Matlab to find the root of the equation by using
   a. Bisection Method
   b. Regula Falsi
   c. Newton Raphson Method
6. To evaluate the given function using trapezoidal and Simpson's method using Matlab.
7. To evaluate the given function using Euler's and Runge-Kutta method using Matlab.
8. To study optimization methods in R software.
9. To study optimization methods used in various process simulators.

Reference Text Books:

1. S. S. Rao, Engineering Optimization: Theory and Practice, Third Edition, Wiley Eastern Ltd.
2. S. C. Chapra, R. P. Canale, Numerical Methods for Engineers, Sixth Edition, McGraw Hill Publications.
3. K. Deb, Optimization for Engineering Design, Prentice-Hall

4. Edger, Himmelblau, Lasdon, Optimization of Chemical Processes, McGraw-Hill International Edition

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 and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
10	20	25	25	10	10

Instructional Method:

a. 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.

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

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

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

Design Based Problems (DP)/ Open Ended project (OEP):

In the beginning of the session, subject faculty will allot an OEP / DP to the students. Students will be free to choose a topic of their choice which will be relevant to the syllabus and they will either prepare a working model/ report / presentation / poster on their topic.