

# Process Modeling and Optimization [PMO]

(Elective – I)

B.E. Sem. VII [INST]

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## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	25
Term Work	–	25

## SYLLABUS

### 1. Mathematical Modeling

Use of mathematical models and principles of formulation, Fundamental laws: Continuity equations, Energy equation, Equations of motion, Chemical kinetics, Modeling of CSTR (isothermal, non-isothermal, constant holdup, variable holdup)

### 2. Introduction to Optimization

Definition and meaning of optimization, need of optimization, conventional versus optimum design process, optimization problem formulation – statement of an optimization problem, terminology, design vector, objective function, design constraints, constraint surface, Iteration, convergence, classification of optimization problem, engineering applications of optimization.

### 3. Classical Optimization Techniques

Fundamental concepts- local and global minima, local and global maxima, quadratic form, necessary and sufficient condition of single and multivariable optimization with no constraints, multivariable optimization with equality and inequality constraints(Kuhn-Tucker condition), Lagrange Theorem.

### 4. Linear Programming

Definition of linear programming problem (LPP), standard form of LPP, terminology, basic concepts, Simplex Algorithm and flowchart, simplex method, two-phase simplex method, Big-M method, Duality in LPP.

### 5. Numerical Methods for Unconstrained Optimum Design

General algorithm for constrained and unconstrained minimization methods, rate of convergence, unimodal and multimodal function, reduction of a single variable, one dimensional minimization methods- Equal Interval method, Golden section search method, Polynomial Interpolation : Quadratic Interpolation method, Cubic Interpolation method, Gradient of a function, properties of gradient vector, Steepest Descent, Conjugate gradient (Fletcher-Reeves), Quasi-Newton method: Davidon-Fletcher-Powell, Broyden-Fletcher-Goldfarb-Shanno.

### Reference :

1. Optimization (*S. S. Rao*) 2<sup>nd</sup> edition, New Age International (P) Ltd., Publishers, New Delhi, 1995.
2. Introduction to Optimum Design (*Jasbir S. Arora*) ELSEVIER, Academic Press, USA – 2004.
3. Optimization of Chemical Processes (*T. E. Edger and D. M. Himmelaue*) McGraw Hill International Editions, 1989.
4. Optimization for Engineering Design (*Kalyanmoy Deb*) Prentice Hall of India (P) Ltd., New Delhi, 1998.
5. Optimization concepts and applications in Engineering (*Ashok D. Belegundu*) Pearson Education, 2002.
6. Operation Research (*Hamby A. Taha*) Pearson education - 2007.

