GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (COMPUTER AIDED PROCESS DESIGN) (16)
CHEMICAL PROCESS OPTIMIZATION
SUBJECT CODE: 2721602
SEMESTER: II

Type of course: Core-III (M.E.CAPD)

Prerequisite: Knowledge of Linear Programming and basics of optimization

Rationale: Important for understanding the optimization for chemical processing.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Optimization: Basic concept of optimization, Mathematical formulation of optimization problems; Classification of Optimization Problems - single variable problems, Multivariable problems without constraints, Multivariable problems with constraints, Maximization and minimization problems, Convex and concave functions, Necessary and sufficient conditions for stationary points.	8	15
2	Optimization of Unconstrained Functions One-Dimensional Search: analytical methods, Numerical methods, scanning and bracketing techniques, region elimination techniques, examples.	7	15
3	Multivariable Search – Analytical Methods: classification, stationary points, direct substitution, constrained variation, penalty function, Lagrangian Multiplier, Kuhn-Tucker theorem, Simplex Method of Linear Programming, Duals in optimization, Quadratic programming, Geometric Programming.	8	15
4	Multivariable Search – Numerical Methods: general principles of numerical search, direction of search, final stage in search, direct search, pattern search, acceleration in direct search, gradient methods, the complex method of Box,	8	15
5	Non- Linear Programming With Constrained And Its Applications: Quadratic programming, Generalized reduced gradients methods, Successive linear and successive quadratic programming, Dynamic programming, Integer and mixed integer programming.	7	15
6	Application of Optimization In Chemical Engineering: Optimization of staged and discrete processes, Optimal shell-tube heat exchanger design, Optimal pipe diameter, Optimal design of an Ammonia reactor.	8	15

7	Non-traditional Optimization Techniques: Statistical Optimization Techniques - Genetic Algorithm, Simulated Annealing, Ant Colony Optimization, TABU search, Multi Objective Optimization.	8	10

Reference Books:
1. Optimization in Chemical processes Edgar, Himmeiblau, Lasdon, by McGrawHill Publication
2. Optimization Theory and Practice Gordon S.G. Beveridge and Robert S. Schechter, by McGrawHill Publication
3. Engineering Optimization –Theory and Practice Singiresu S.Rao, Published by New Age International publishers
4. Product and Process Design Principles Warren D Seider, J. D. Seader, Daniel R Lewin, by John Wiley and Sons,Inc.
5. Systematic Methods of Chemical Process Design Lorens T. Biegler , E.Ignacio grossmann, Arthur W Westerberg , byPHI
6. Engineering Optimization Methods and Applications Rekllaities F. V., Ravindan A. and Ragsdell K. M., John Willy, New York, 1983.

Course Outcome:
After learning the course the students should be able to:

- Understand the importance of optimization in Chemical Engineering.
- Learn ths different methods and techniques for Optimization of Unconstrained Functions One-Dimensional Search .
- Learn the simplx methods for linear programming, Quadratic programming and Geometric programming.
- Understand the Multivariable Search – Numerical Methods.
- Know about the Non- Linear Programming With Constrained and Its Applications
- Able to use optimization techniques and theory in real chemical engineering field.
- Learn about the Nontraditional Optimization Techniques and able to apply in chemical engineering field.

Major Equipment:

Computers, different Software etc

List of Open Source Software/learning website:

- https://www.vrand.com/education.html
- www.liacs.nl/~emmerich/pdf/EGH+00.pdf
- www.aspentech.com/products/aspen-plus.aspx
- macc.mcmaster.ca/maccfiles/chachuatnotes/02-BasicsI_handout.pdf

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.