

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (COMPUTER AIDED PROCESS DESIGN) (16)

COMPUTER AIDED PRODUCT & PROCESS DESIGN

SUBJECT CODE: 2731602

ME Semester: III

Type of course: Major Elective-IV

Prerequisite: Energy & Mass integration(EMI).

Rationale: Able to understand the importance of simulation to assist process design in chemical engineering field.

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#	2	5	70	30	20	10	10	10	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended Problem.

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	Product and Process Design: Steps in Product and Process Design, Environment Protection, Safety Considerations, Engineering Ethics, Process Creation, preliminary database creation and process synthesis, development of base-case design, simulation to assist process creation, heuristics for process synthesis, Equipment Sizing and Costing.	7	15
2	Design and Scheduling of Batch Processes: Single product batch plants, Multiple product batch plants, Transfer policies, Parallel units and intermediate storage, Sizing of vessels in batch plants, Inventories, Synthesis of flow shop plants.	7	15
3	Optimal design and scheduling of multi-product batch plants: constraints for flow shop plants, MINLP design model for flow shop plants, MILP reformulation for discrete sizes, NLP design model-Mixed product campaigns, Cyclic scheduling in flow shop plants.	7	15
4	Geometric Techniques for the Synthesis of Reactor Networks: Graphical techniques for simple reacting system, Geometric concept for attainable regions, Reaction invariants and reactor network synthesis.	6	10
5.	Optimization Techniques for Reactor Network Synthesis: Reactor Network Synthesis with targeting formulation, Non-isothermal systems, Improvement to the targeting algorithm, Reactor Network Synthesis in process flow sheets, Energy integrating in reactor networks.	7	15
6	Synthesis and Optimization of Distillation Sequences: Goal of system design, Minimum vapor flows, Marginal vapor flows, Liner	7	10

	model for sharp split columns, MILP model for distillation sequences, MILP model for continuous and discrete temperature, Design and synthesis with rigorous models.		
7	General concept of Simulation for Process Design: Introduction, Process Simulation Modes, methods for solving Non linear equations, recycle partitioning and tearing, simulation examples.	6	10
8	Process Flow Sheet Optimization: Constrained nonlinear programming, successive quadratic programming, process optimization with modular simulators, equation oriented process optimization.	7	10

Reference Books:

1. Product and Process Design Principles : Second Edition Warren D Seider, J. D. Seader, Daniel R Lewi Published by John Wiley and Sons, Inc.
2. Systematic Methods of Chemical Process Design : Lorens T. Biegler , E.Ignacio grossmann, Arthur W Westerberg Published by-Prentice Hall International, Inc

Course Outcomes:

After learning the course the students should be able to:

1. Learn about the Environment Protection, Safety Considerations & Engineering Ethics.
2. Understand the Design and Scheduling of Batch Processes.
3. Learn about the Graphical Techniques for simple reacting system.
4. Learn about the Energy Integrating in reactor networks.
5. Understand the General Concept of Simulation for Process Design.

List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

Design based Problems (DP)/Open Ended Problem:

1. Sustainability of Products, Processes and Supply Chains Theory and Applications.
2. A Genetic Algorithm For Synthesis And Optimization of Reactor System.
3. Synthesis of Optimal Chemical Reactor Networks.
4. Synthesis and Optimization of Distillation Column Sequences for Separation of Multicomponent Products .

Major Equipment's:

- Batch Reactor, Computers, softwares, Distillation Column etc.

List of Open Source Software/learning website:

- <http://www.sciencedirect.com/>
- <http://citeseerx.ist.psu.edu/>
- <http://repository.cmu.edu/>
- <http://www.nt.ntnu.no/>

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.