First Semester 2016-2017
Course Handout (Part-II)

Date: 02/08/2016

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No.	**: CHE F314**
Course Title	**: Process Design Principles I**
Instructor-in-Charge	**: SURESH GUPTA**
Instructor (Tutorials)	**: Subhajit Majumder, Shweta Sharma**

Course Description

Process invention using heuristics and analysis (The Design process, Process creation and heuristics for process synthesis, Role of process simulators like Aspen Plus in process creation), Strategic designs in process synthesis and analysis, Detailed process synthesis using algorithmic methods with emphasis on reactor networks, separation trains, batch processes, heat and mass integration, energy integration analysis; pinch technology.

Scope & Objective

This course introduces the student to the strategy of process engineering and provides an insight into various aspects of process design. This course mainly deals with the process synthesis part of process design. It covers in detail the preliminary process synthesis, developing base case design and use of heuristics for choosing the best from various process alternatives.

Text Books

T1 Warren D. Seider, J. D. Seader, and Daniel R. Lewin, "Product & Process Design Principles: Synthesis, Analysis, and Evaluation", Wiley-India Edition, India, 2nd Edition (2004).

T2 James M. Douglas, "Conceptual Design of Chemical Processes", McGraw Hill, New York, International Edition (1988).

Reference Books:

R1 Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz, and Debangsu Bhattacharyya, "Analysis, Synthesis, and Design of Chemical Processes", International Edition, Pearson Education International, New Jersey (2012).

R2 Robin Smith, "Chemical Process Design", International Editions, McGraw Hill, Singapore (2000).

R3 Dale F. Rudd, and Charles C. Watson, "Strategy of Process Engineering", John Wiley & Sons, New York (1968).

Course Plan

Lecture No.	Learning Objectives	Topics to be covered	Reference Chap./Sec. (Book)
1	Introduction	Introduction to Process Design Decisions: Process Synthesis and Analysis.	Ch. 1 of T1 and T2
2-4	Nature of Process Synthesis and Analysis	Creative aspects, Hierarchical approach to conceptual design, HDA Process. Preliminary Process Synthesis with examples.	Ch. 3 of T1 and Ch. 1 of T2
5	Engineering Economics for Conceptual Design	Important cost terms, Cost information, Capital and operating cost estimation, Total capital investment for process.	Ch. 2 of T2
6-10	Economic Decision Making	Design of a solvent recovery system, Problem definition, Design of a gas absorber, Flow sheet, material and energy balances, and stream costs, Equipment design considerations, Rules of thumb.	Ch. 3 of T2
11-14	Simulation to assist in Process Simulation	Concepts of process simulation, Steady and unsteady state simulation. Introduction to Aspen Plus.	Ch. 4 of T1 and Class notes
15-16	Input Information and Batch vs. Continuous	Input information, Level-1 decision (Batch vs. continuous), Systematic procedure for the design of batch processes. Economic Potential (EP-1).	Ch. 4 of T2
17-20	Input-Output Structure of the Flow sheet	Level-2 Decisions (Input-output structure), Design variables, Selectivity and reaction stoichiometry, Overall material balances, Stream costs, Process alternatives, Economic potential (EP-2).	Ch. 5 of T2
21-24	Recycle Structure of the Flow sheet. Reactor Design and Reactor Network Synthesis	Level-3 Decisions (Recycle structure), Recycle material balances, Reactor heat effects, Equilibrium limitations, Compressor design and costs, Reactor design, Economic potential (EP-3).	Ch. 6 of T1 and Ch. 6 of T2
25-28	Separation System	General structure, Vapor recovery system, Liquid separation system, Azeotropic systems, Rigorous material balances, Economic potential (EP-4).	Ch. 7 of T1 and Ch. 7 of T2
29-37	Energy Integration Analysis	Heat-Exchanger Network Synthesis (HENS), First law analysis, Cascade diagrams, Temperature-Enthalpy Diagrams, Grand composite curve, Multiple utilities, Area estimates, Design of MER Networks, Loops and paths, Final design, Stream splitting, Complete design algorithm, Heat and power integration.	Ch. 10 of T1 and Ch. 8 of T2
38-40	Mass Integration	Introduction, Minimum mass separation agent, Mass exchanger networks.	Ch. 11 of T1

Evaluation Scheme

EC No.	Evaluation component (EC)	Duration (Minutes)	Weightage (300)	Date and time	Nature of component
1	Mid-Semester Test	90	75	<TEST_1>	Closed Book
2	Tutorials/Surprise Tests#	-	60	-	Open/Closed Book
3	Assignment*	-	45	To be announced in the class in due course of time	Open Book
4	Comprehensive Examination	180	120	<TEST_C>	Closed Book/Open Book

#Total **five tutorial tests** and **three surprise tests** will be conducted. Out of these, the performance in **best four tutorial tests** and **best two surprise tests** will be considered for final evaluation. During tutorial and surprise tests, students will be asked to solve problems (numerical/objective/subjective type) and submit the answer sheet to the instructor.

*Conceptual design oriented problems/case studies will be given as Assignment.

Chamber Consultation Hour: To be announced in the class.

Make-up policy: Make-up will be granted only for genuine reason(s) (medical ground only) for not appearing in the regular test. Proper proofs (medical certificate, prescription etc. from Medical Center) must be submitted along with Make-up application. **Prior permission of IC is compulsory**.

Notices: All notices concerning this course will be displayed on the Notice Board of Chemical Engineering Department and will also be available online on NALANDA Portal.

Instructor-in-charge
CHE F314