BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
First Semester 2022-2023
Course Handout (Part-II)

29-08-2022

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 (IC) : **Dr. Arnab Dutta**
Office No. of IC : **D216**

Scope & Objective:

The course as a whole, Process Design Principles, is designed to bring together the concepts of engineering and economics for chemical plant design and optimization. In the first part of this course (i.e., **Process Design Principles I**) in this semester will combine the individual aspects of chemical engineering such as fluid mechanics, mass transfer, heat transfer, chemical reaction engineering, chemical process calculations, thermodynamics, etc. for designing different chemical processes. Knowledge of different process heuristics followed by the design of separation trains, reactor networks, heat exchanger networks, and process integration will be discussed. The students will be exposed to process simulation via hands-on sessions in Aspen HYSYS,which is a commonly used process simulator in chemical engineering domain spanning both academia and industries.

On completion of this course, students should be able to appreciate the following **learning outcomes**:

- Understand different heuristics pertaining to process synthesis
- Develop process flowsheet simulations using Aspen HYSYS
- Synthesize separation trains and reactor networks
- Design heat exchanger networks for maximizing energy recovery or minimizing total costs
- Apply process design and synthesis concepts in the chemical engineering domain

Text Book:

T1 Warren D. Seider, J. D. Seader, and Daniel R. Lewin, "**Product & Process Design Principles: Synthesis, Analysis, and Evaluation**", John Wiley & Sons, New York, 3rd Edition, I.S.V. [Reprint: 2017]

Reference Book:

R1 Robin Smith, "**Chemical Process: Design and integration**", John Wiley & Sons, New York, 2nd Edition [2016].

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapters in the Text Book
1-4	Introduction	Product design Process synthesis	Ch.: 1, 2, & 4 (T1)
5-10	Process Simulation	Introduction to process simulator: Aspen HYSYS Simulation modules: Physical & Logical Steady-state flowsheet simulations	Ch.: 5 (T1) Additional reference materials will be provided
11-14	Process	Heuristics associated with different unit operations	Ch.: 6 (T1)

	Synthesis Heuristics		
15-18	Separation Train Synthesis	Sequencing of distillation columns for separating near ideal fluid mixtures	Ch.: 8 (T1) Ch.: 11 (R1)
19-22	Reactor Networks	Reactor models Reactor network design	Ch. 7 (T1)
23-27	Heat Exchanger Networks (HEN)-I: Energy Target	Maximum energy recovery (Minimum utility consumption) Pinch analysis Temperature-Interval method Composite curve method	Ch.: 9 (T1) Ch.: 16 (R1)
28-32	Heat Exchanger Networks (HEN)-II: Total cost Target	Minimizing annual (capital & operational) costs Reduce number of Heat Exchangers: Breaking heat loops Reduce number of Heat Exchangers: Stream splitting HEN: Superstructure	Ch.: 9 (T1) Ch.: 17, 18 (R1)
33-34	Process Integration	Data extraction Heat-Integration	Ch.: 9 (T1) Ch.: 19, 21 (R1)
35-40	Research Applications	Property prediction via group contribution methods (GCM) MATLAB-HYSYS integration Process optimization	Ch. 3 (T1) Experiential learning through research papers

Note: Weekly tutorial sessions will be based on using Aspen HYSYS as the process simulator, which will take place in the CAD Lab (D208-A).

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date & Time	Nature of Component
1.	Mid-Sem	90 min	25	01/11/2022 [1:30 – 3:00 pm]	Open Book
2.	Comprehensive	180 min	35	21/12/2022 FN	Open Book
3.	Assignments (2)	TBA	20	Equally-spaced out	Open Book
4.	Tutorial Sessions	TBA	10	During tutorial classes	Continuous Assessment Open Book
5.	Viva (1)	TBA	10	Tentatively towards the end of semester	Closed Book

Chamber Consultation Hour: TBA

Notices: All notices concerning this course will be displayed on the Chemical Engineering Notice Board

Make-up Policy: Make-up is granted only for genuine cases with valid justifications at the discretion of the IC. A prior permission from the Instructor-in-charge is required. Decision of the IC will be final. There will be NO provision for Make-up w.r.t. assignments, tutorial sessions, and viva components.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Arnab Dutta

Instructor-in-charge
(Dr. Arnab Dutta)
CHE F314