CBE 400
INTRODUCTION TO PRODUCT AND PROCESS DESIGN
FALL 2018

Lecture: MWF: 9:00am – 9:50am: 313 Towne
Recitation: M: 5:00pm – 6:30pm: 313 Towne
No Classes: 09.03 (Labor Day), 10.05 (Fall Break), 11.23 (Thanksgiving Break)
Office Hours: Scheduled before homework assignments are due (mostly Wednesdays):
Rooms: TBA, Times: TBA

Instructors: **Prof. Warren D. Seider;** 372 Towne; 215-898-7953; seider@seas.upenn.edu
Dr. Sean P. Holleran; 354 Towne; 215-898-9879; seanholl@seas.upenn.edu
Prof. Bruce M. Vrana; 312 Towne; 302-695-4852; 302-690-0032; vranab@seas.upenn.edu
Prof. Leonard A. Fabiano; 312 Towne; 610-745-2892; lfabiano@seas.upenn.edu –
both active in CBE 459, less active in CBE 400

Teach Asst: Wilfredo Mendez Ortiz; 352 Towne / M42; 787-340-5349; wmendez@seas.upenn.edu
Jessica Schwartz; 703-576-7603; schjess@seas.upenn.edu

Text: **Seider, W.D., D.R. Lewin, J.D. Seader, S. Widagdo, R. Gani, and K.M. Ng, *Product and Process Design Principles: Synthesis, Analysis, and Evaluation,* Fourth Edition, Wiley, 2017.**

Outline:
Introduction to Chemical Product Design (new-4E) / Chap 1
Energy Sources (new-4E) / Chap 3
Engineering Ethics (new-4E) / Chap 3
Process Creation – Preliminary Process Synthesis (revised-4E) / Chap 2
Heuristics for Process Synthesis (revised-4E) / Chap 6
Process Simulation – ASPEN PLUS (revised-4E) / Chap 7
Synthesis of Separation Trains, Azeotropic Distillation (revised-4E) / Chap 9
Second Law Analysis – Thermo Efficiency, Lost Work Analysis (new-4E) / Chap 10
Synthesis of Heat Exchanger Networks (revised-4E) / Chap 11
Detailed Equipment Design – including HX Design (revised-4E) / Chap 12, 13
Capital Cost Estimation; Time Value of Money (revised-4E) / Chap 17
Profitability Analysis (revised-4E) / Chap 17
Selection of Design Projects for CBE 459; Begin Work on Design Projects for CBE 459

Exams:	1 hour [First Exam] (25%)	Wednesday, October 3 (9:00am – 9:50am)
	1 hour [Second Exam] (25%)	Friday, November 16 (9:00am – 9:50am)
	2 hours [Final Exam] (40%)	***Thursday, December 20 (9:00am – 11:00am)***

Homework: All assignments must be submitted. Homework will not be graded – solutions will be evaluated by the TAs and returned to the students. Students are responsible for concepts.

Participation: Be an active part of this course – participate in lecture, office hours, Monday PM recitations. Each instructor (WDS, SpH, WMO, JS) will evaluate the participation level for each of the students. Participation will count for 10% of your CBE400 grade.

Fall Picnic: Sun., Sep. 23, noon – Seider home, 6 Rose Valley Rd, Rose Valley, PA; 610-566-0905; Volleyball, basketball, croquet, badminton; Short walk from Moylan-Rose Valley Station;

Course Learning Objectives:

After completing this course, students will:

1. have been introduced to the strategy of product design involving basic chemicals, devices, functional, and formulated chemical products.

2. be able to carry out process synthesis using heuristics and process simulation methods.

3. have carried out several process simulations using ASPEN PLUS and SUPERPRO DESIGNER.

4. have learned to synthesize distillation trains for nearly-ideal mixtures, and have been introduced to the synthesis of distillation trains for azeotropic mixtures.

5. be able to carry out second-law analysis; that is, calculate the lost work and thermodynamic efficiency for a chemical process.

6. be able to carry out heat integration of process flowsheets.

7. be able to design a heat exchanger

8. be able to size and estimate the costs for distillation complexes, heat exchangers, pumps, compressors, expanders, and other kinds of equipment, using many cost equations.

9. be able to carry out a profitability analysis for a chemical process design.

10. have been assigned a CBE 459 product/process design project, and through solution of many homework exercises, be prepared to carry out the design effectively.

CONSIDERATIONS IN DESIGN COURSES

Prior Courses

	New Concepts in Design Courses
Material and Energy Balances	Few
Thermodynamics	Few
Fluid Mechanics	Few
Heat and Mass Transfer	Few
Separations	Few
Reactor Design	In Parallel
Process Control	In Parallel

Design Course Emphasis

How to design a chemical product/process using these concepts

How to identify the important alternatives – how to select the best (optimize)

Like painting a painting, composing a symphony – using the basics

How to work in a team to design a product/process

Prepares you for work as a chemical engineer – in industry and government labs, pharmaceutical, food, and electronic materials, manufacturing facilities, and so on.

Textbook

Attempts to cover important design subjects

Accompanies lectures – which draw attention to important subjects

Lectures help you navigate

Homework exercises often involve techniques described in textbook

Warning – for some subjects, has more detail than you need

For example, Chapter 16 – for some designs, too much detail for selecting and sizing equipment – important only when needed. Lectures and homework exercises try to indicate the level of detail needed.

On your design projects, industrial consultants often help you navigate.