

**CBE 400**  
**INTRODUCTION TO PRODUCT AND PROCESS DESIGN**  
**FALL 2011**

MWF 9-10 a.m., Rm. 311 Towne

M 5:00-6:30 p.m., Rm. 311 Towne – Sept. 19, 26; Oct. 3, 24; Nov. 7, 14, 28; Dec. 5

No classes – Sept. 30, Oct. 10 (Fall Break), 25 (Thanksgiving Break)

Office hours – Scheduled before homework assignments are due, Rooms 336 or M70

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**Text:** Seider, W.D., J.D. Seader, D.R. Lewin, and S. Widagdo, *Product and Process Design Principles: Synthesis, Analysis, and Evaluation*, Third Edition, Wiley, 2009.

Lewin, D. R., et al., *Using Process Simulators in Chemical Engineering: A Multimedia Guide for the Core Curriculum*, available from Wiley web site associated with textbook.

**Outline:** Introduction to Chemical Product Design  
Molecular Structure Design  
Process Creation - Preliminary Process Synthesis  
Process Simulation - ASPEN PLUS, BATCH PLUS, SUPERPRO DESIGNER  
Heuristics for Process Synthesis  
Synthesis of Separation Trains  
Second Law Analysis - Thermodynamic Efficiency, Lost Work Analysis  
Synthesis of Heat Exchanger Networks  
Detailed Equipment Design  
Industrial Product Design  
Configured Consumer Product Design  
Capital Cost Estimation  
Profitability Analysis  
Selection of Design Projects for CBE 459

**Exams:** 1 hour, Wednesday, October 19  
1 hour, Monday, November 21  
2 hours, Final Exam, Thursday, December 15, 9:00 – 11:00 a.m.

**Homework:** Average for all homework = 1 exam grade  
All assignments must be submitted

**Web Sites:** For the latest information concerning CBE 400, access the Product and Process Design Web Page ([www.seas.upenn.edu/~seider/design.html](http://www.seas.upenn.edu/~seider/design.html)). Also, see [www.courseweb.upenn.edu](http://www.courseweb.upenn.edu) to obtain the latest homework assignments and course announcements.

## Course Learning Objectives:

After completing this course, students will:

1. have been introduced to the strategy of product and process design involving commodity and specialty chemicals, including pharmaceuticals and configured consumer products.
2. have been introduced to methods of selecting chemicals having desired properties using molecular structure design.
3. be able to carry out process synthesis using heuristics and process simulation methods.
4. have carried out several process simulations using ASPEN PLUS and BATCH PLUS.
5. have learned to synthesize distillation trains for nearly-ideal mixtures, and have been introduced to the synthesis of distillation trains for azeotropic mixtures.
6. be able to carry out second-law analysis; that is, calculate the lost work and thermodynamic efficiency for a chemical process.
7. be able to carry out heat integration of process flowsheets.
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 profitability analyses using approximate and rigorous methods, and using a profitability analysis spreadsheet.
10. have been introduced to some of the steps in designing industrial and configured consumer products.
11. 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.