

1. **Course number and name - CHBE 4510**
Process and Product Design and Economics (required)
2. **Credits and contact hours** - 2 credit hours, 2 lecture hours (2-0-0-2)
3. **Instructor's or course coordinator's name** - Dr. Yonathan Thio
and Dr. Christian Cuba-Torres
4. **Textbook, title, author, and year**
Sieder, Seader, Lewin, and Widagdo, "Product and Process Design Principles", 3rd Edition, Wiley, 2008.
5. **Specific course information**
 - a. **Catalog Description** – Basic principles of chemical process and product design including heuristic design approaches, heat exchanger network design, optimization, and economic evaluation. Credit not allowed for both CHBE 4510 and CHBE 4505 (or CHBE 4525).
 - b. **Prerequisites or co-requisites** – CHBE 3210 Transport Phenomena II (grade "C" or better); CHBE 3225 Separations Processes (grade "C" or better); CHBE 4300 Kinetics and Reactor Design (grade "C" or better).
 - c. **Required, elective, or selected elective course** (as per Table 5-1) – Required
6. **Specific goals for the course**
 - a. **Specific outcomes of instruction:**

By the end of this course, a student should be able to:

 - 1) Be knowledgeable about the kinds of design decisions that challenge process design teams.
 - 2) Understand the key steps in carrying out the design of a chemical process.
 - 3) Be aware of the many kinds of environmental issues and safety considerations in process design.
 - 4) Appreciate the importance of maintaining high ethical principles in process design.
 - 5) Understand process simulators and be able to use them in process creation, equipment sizing and costing, profitability analysis, and optimization.
 - 6) Understand the importance of selecting reaction paths that do not involve toxic or hazardous chemicals, and when unavoidable, to reduce their presence by shortening residence times and reducing storage.
 - 7) Be able to distribute the chemicals, when designing a process flowsheet, to account for the presence of inert species, to purge species that would otherwise accumulate to unacceptable levels, to achieve high selectivity to the desired products, and to accomplish reactions and separations in the same vessel when possible.
 - 8) Be able to apply heuristics in selecting chemical reactors or reactor trains, and in selecting separation processes to separate liquids, vapors, vapor-liquid mixtures, and vapor-liquid-solid mixtures.

- 9) Be familiar with the most widely used industrial separations and their basis for separation.
- 10) Understand how distillation columns are sequenced and how to apply heuristics to narrow the search for a near optimal sequence.
- 11) Be able to determine the second law efficiency of a process and pinpoint the major areas of inefficiency (lost work).
- 12) Understand the concepts and application of heat and power integration to minimize energy requirements for chemical process plants.

b. Connection with Student Outcomes

CHBE 4510							
Course Outcomes	Student Outcomes						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Course Outcome 1	X	X	X	X	X		X
Course Outcome 2	X	X				X	
Course Outcome 3			X	X			X
Course Outcome 4			X	X			X
Course Outcome 5	X	X				X	
Course Outcome 6	X	X		X		X	
Course Outcome 7	X	X					
Course Outcome 8	X						
Course Outcome 9	X						
Course Outcome 10	X						
Course Outcome 11	X						
Course Outcome 12	X						

Student Outcomes

- (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*
- (2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors*
- (3) an ability to communicate effectively with a range of audiences*
- (4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts*
- (5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives*
- (6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions*
- (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies*

7. Brief list of topics to be covered

- a. Introduction to process design
- b. Production routes and profit upper bound
- c. Flowsheet preparation
- d. Process design heuristics
- e. Integration of reactors and separators
- f. Accounting
- g. Equipment sizing and design
- h. Chemical plant economics
- i. Pumps and compressors

- j. Heat and energy integration
- k. Optimization of chemical processes