

ChE 4083 Chemical Engineering Plant Design

Required course for ChE program

Catalog Description: Design of chemical and petrochemical plants and process equipment. Evaluation of the economic, safety, health, and environmental aspects of a proposed project. Use of spreadsheets and state-of-the-art process simulators. Oral and written reports. Prerequisites: ChE 4063, ChE 4104.

Recent Textbook: Peters, Timmerhaus, and West, "Plant Design and Economics for Chemical Engineers", 5th ed., McGraw-Hill, 2003

Recent References: Perry's ChE Handbook, 7th ed., McGraw-Hill; Walas, "Chemical Process Equipment – Selection and Design", Butterworths, 1988; Ulrich and Vasudevan, Chemical Engineering Process Design and Economics, 2nd ed. 2004; HYSYS manual.

Set of Course Goals/Objectives: By the end of the course, students will be able to:

1. Develop and optimize a complete process flow diagram
2. Develop mass and heat balances and determine utility duties for a plant
3. Size the major equipment units using process simulation software where advantageous
4. Recommend the type and location for process controls in a plant.
5. Develop a complete cash flow analysis including FCI, major annual costs, and ROR
6. Evaluate the safety, health, and environmental aspects of a proposed project
7. Write a preliminary project definition report
8. Work effectively in teams.

Prerequisites by Topic: senior standing in ChE: must have had stoichiometry, basic and ChE thermodynamics, fluid mechanics, heat transfer, mass transfer, reactor design, and process component design.

Major Topics Covered in the Course: Teams of 3 or 4 students solve two, recent AIChE National Student Design Competition problems. Group members take turns at being group leader. The coordinators lead the class through the first problem, dividing the problem into feasibility studies, material balances, heat balances, equipment sizing, economic evaluation, and report preparation. The instructors "keep" all groups at approximately the same pace by providing detailed help when required. In the second problem, the groups are "on their own," and each group works on a recent AIChE National Student Design Competition problem and progress at their own capabilities. During the second problem, the groups continue to make weekly written progress reports. For each second design problem, the responsible group prepares a final report and also makes a final oral presentation during finals week. As an alternative to the second design problem, students can and do elect to take the current AIChE National Design Competition under contest conditions. In addition to the design report, the group presents their design to the entire class.

Class/Laboratory Schedule: two 50-minute lectures and one 3-hour computational lab session per week for 14 weeks

Professional Component: Three hours of engineering science and design

Relationship to Student Outcomes	
outcomes:	Description of related course content:
(a) an ability to apply knowledge of mathematics, science and engineering	The course requires solution of two design projects that inherently involve applying mathematics, science and engineering. The design projects build on the students entire prior course work. Whenever necessary, the theoretical basis for sizing equipment is reviewed.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	The design projects inherently require all these outcomes.
(d) an ability to function on multi-disciplinary teams	The design projects are done in teams. Amicable teamwork is a necessity. All group members take turns in being group leader.
(e) an ability to identify, formulate, and solve engineering problems	Successful engineering design requires these skills. .
(f) an understanding of professional and ethical responsibility	The majority of the class has taken and passed the F.E. exam. They are starting to realize the professional and ethical responsibilities that will soon be theirs. Designs include estimating emissions, and safety considerations.
(g) an ability to communicate effectively	Over half the instruction time is spent in getting the students to document their calculations and write the final report in accordance with the detailed AIChE Design competition guidelines. Oral presentations are required for the second design problem.
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	The economic trade-offs and environmental impacts (e.g., noise pollution) of design are emphasized. The design project often has an economic or environmental component.
(i) a recognition of the need for, and an ability to engage in life-long learning	
(j) a knowledge of contemporary issues	Current events relating to the design projects are introduced whenever appropriate. Emissions, health, and safety are considered throughout the course.
(k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	Students are required to use computers to solve many problems throughout the course. HYSYS, Word, and Excel are required.

Revised by: Francis. S. Manning, P.E. and Keith D. Wisecarver, P.E., with input from the ChE Industrial Advisory Board 1/10/08

Revised by Francis S. Manning, P.E. and Keith D. Wisecarver, P.E., 5/6/08
Course objectives from Spring 2009 added by G. L. Price

Modified 3/20/2012 to remove old ChE criteria - GLP