

**CHEN 4470 - PROCESS DESIGN PRACTICE (3)**  
**Required Core Course**

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**2009-2010 Catalog Data**    **Lec (2), Lab (3).** Flow sheet simulation and techno-economic analysis applied to complex, open-ended chemical processes. Screening of alternatives and economic optimizations. Capstone design course.

**Prerequisites**                    Pr: CHEN 3AA0, CHEN 4450 and CHEN 4460.

**Schedule**                        Two one-hour class sessions, and two 75-minute lab sessions per week

**Course Objectives**            This course is designed to integrate chemical engineering concepts in designing complex industrial facilities.

**Textbooks**

Seider, Seader, Lewin and Widagdo, Product and Process Design Principles: Synthesis, Analysis, and Evaluation, 3e, 2008, 9780470048955, Wiley

**Lecture Topics**

1.      Course introduction: project overview, report contents (1 week)
2.      Mass integration: synthesis of mass exchange networks, graphical mass integration techniques, algebraic mass integration techniques (3 weeks)
3.      Advanced column design: reactive distillation, reboiler selection and design, design of overhead condensers and air-cooled heat exchangers (1 week)
4.      Physical property prediction and computer aided molecular design (0.5 weeks)
5.      Managing and supervising major engineering projects (0.5 weeks)
6.      Product design and six sigma (0.5 weeks)
7.      Process risk assessment and inherently safe process design (1 week)
8.      Integration of design and control (1.5 weeks)
9.      Role of design engineers in technology development (0.5 weeks)
10.     Final reports and oral presentations (1 week)
11.     Additional project specific lectures are included each year, but the content varies depending on the project, e.g. in 2009 lectures on esterification processes were added, whereas in 2010 lectures on coal/biomass gasification were included. (4.5 weeks)

**Laboratory Topics**

1.      Complex, open-ended design problem (15 weeks): Recent projects include:
  - a.      Design of a Fischer-Tropsch Synthesis process for production of liquid fuels (2011)
  - b.      Design of acetic acid production from coal/biomass resources through gasification, methanol synthesis and carbonylation (2010)
  - c.      Design of butyl-acetate manufacturing process (2009)
  - d.      Design of sodium methylate process (2008)
  - e.      Design of a sustainable acrolein manufacturing process from dehydration of glycerin (2007).

**Course Outcomes:** Upon successful completion of this course, students should be able to:

1.      Formulate and evaluate process and/or product design objectives and constraints for an open-ended problem.
2.      Synthesize a process flowsheet capable of achieving the stated process and/or product objectives subject to a given set of constraints, by employing traditional as well as novel synthesis and design strategies.
3.      Develop a rigorous steady state computer simulation of the process flowsheet, using commercially available software packages, capable of representing the process.

4. Evaluate chemical processing equipment alternatives for each processing step and select the appropriate candidates.
5. Perform equipment design using sizing methods provided by a process simulation package and perform cost estimation using computer aided tools as well as empirical correlations.
6. Identify the minimum cost potentials for mass and energy integration with special emphasis on sustainability, resource conservation, waste minimization and energy recovery.
7. Generate a broad range of feasible alternative designs capable of achieving the process and/or product objectives.
8. Perform economic sensitivity analysis in order to identify the primary process parameters affecting the economics of the process plant.
9. Utilize the understanding of process engineering, economics, environmental concerns as well as health and safety issues to select the optimum solution to a design problem from the generated alternatives.
10. Work in a team on solving an open-ended design project and exhibiting proficiency in developing effective task breakdowns and project plans, time management skills, task delegation and punctuality.
11. Prepare simulation memos and design reports that are properly organized and demonstrate concise, clear language, employing appropriately placed and constructed tables and graphs, with special emphasis on effective communication, neatness and punctuality.
12. Prepare and deliver a professional oral presentation with appropriate visual aids.
13. Identify and utilize traditional as well as novel sources of information such as the World Wide Web, databases, technical journals, and news.

<b>Contribution of Course to Meeting ABET Criteria 5 (Curriculum)</b>		
<b>Math and Basic Sciences</b>	<b>Engineering Topics</b>	<b>General Education</b>
0 Credits	3 Credits	0 Credits

<b>Relationship of Course to Program Outcomes (PO's)</b>												
<b>Program Outcome</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G1</b>	<b>G2</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>
<b>Level of Coverage</b>	R	R	S	S	S	R	S	S	S	S	R	S

**Date of Preparation and Person(s) Preparing This Description**

February 6, 2010: Mario R. Eden