ChE 455/456
Fall 2010/Spring 2011

Chemical Process Design
Fall (4 credits)/Spring (3 credits) = 7 credits

Instructors:

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Schedule:

Fall: Tu Th 8:00 a.m. – 9:15 a.m., 401 Engineering Sciences Building
Tu 1:00 p.m. – 4:50 p.m., 449 Engineering Sciences Building

Spring: Tu 12:30 p.m. – 4:50 p.m., 449 Engineering Sciences Building

Course Objectives:

1. Students will be able to apply knowledge from math, chemistry, physics, thermodynamics, fluid mechanics, heat transfer, separations, and reaction engineering to complex, open-ended chemical engineering problems such as design, performance, troubleshooting, and debottlenecking.
2. Students will be able to perform an economic analysis on complex chemical processes including features such as the time value of money, profitability, depreciation and tax consequences, and incremental analysis.
3. Students will appreciate the ethical, societal, health, safety, and environmental consequences of their work.
4. Students will be able to optimize chemical processes or portions of chemical processes using different objective functions, such as economic and minimum utility consumption.
5. Students will develop their abilities to work individually, in small groups, and in large groups.
6. Students will develop lifelong learning skills such as searching for and finding information, learning material not covered in traditional courses, and making decisions.
7. Students will increase their proficiency in oral and written communication.

Required Text:

Turton, R., R. C. Bailie, W. B. Whiting, and J. A. Shaeiwitz, *Analysis, Synthesis, and Design of Chemical Processes, 3rd ed.*, Prentice-Hall, 2009.

Course Policies (exceptions at discretion of Instructor):

1. There are no make-up exams.
2. All problem sets are due at the beginning of class or at the stated time.
3. A late assignment = no assignment.

4. Exam grading appeals must be submitted in writing on the day the exam is returned. If you miss that class, you lose the opportunity for regrading.
5. Any classes canceled due to inclement weather (or any other reason, such as fire alarms) will be rescheduled.
6. If the fire alarm goes off during an exam, the resolution of the situation is solely at the discretion of the instructors
7. You may (and are encouraged to) work in groups on problem sets. However, what you submit must be your own work. Assignments that are obviously copied will receive no credit.
8. Make sure your cellular phone is turned off. If your cellular phone rings in class, if you are observed texting during class, or if you are observed accessing the internet during class, you will be considered to have an unexcused absence for that class. If this occurs during an exam, you will receive a zero grade for that exam.
9. Problem sets and exams should be neat and easy to follow. Each problem should start on a new page. Your answer should be boxed, have units as appropriate, and have the correct number of significant figures. There will be a 20% deduction, per occurrence, for answers that significantly exceed the correct number of significant figures. Problems should be worked in the units provided (SI or American). No credit will be given for problems not worked in the units provided. No credit will be given for answers without work. Credit will be deducted for missing or incorrect units, sloppy work that is hard to follow, and for the incorrect number of significant figures. You should round off the final answer to the correct number of significant figures. If you round off intermediate calculations, thereby making your final answer inaccurate, significant credit will be deducted.

Grade Scale:

For the Majors and the Group Design categories, letter grades are assigned. Each letter grade has a numerical equivalent as per the table below. However, all grades from 0 to 100 at 2.5-point increments are possible

A++	100	C+	77.5	F	55
A+	97.5	C	75		52.5
A	95	C-	72.5		
A-	92.5	C-/D+	70	every possible	
A-/B+	90	D+	67.5	2.5 increment	
B+	87.5	D	65		
B	85	D-	62.5		
B-	82.5		60		
B-/C+	80		57.5	no work	0

The nominal grading scale is

≥90%	A
≥80%	B
≥70%	C
≥60%	D
<60%	F

At the Instructor's discretion, this scale may be lowered, but not raised.

Grading:

Fall Semester (ChE 455):

	Mid-Term Exam	20%
1	Final Exam	20%
	Problem Sets	10%
2	Design Project	25%
3	Major 1	25%

NOTE: Acceptable (passing grades) performance must be demonstrated in each of the three categories in order to pass ChE 455. If you receive a grade < 60 on major 1, you will be required to repeat the first major. Satisfactory completion of the repeated major will earn you a grade of 60 for the first major.

Spring Semester (ChE 456) (tentative):

1	Design Project	75%
2	Major 2	25%

NOTE: Acceptable performance (passing grades) must be demonstrated in each of the two categories in order to pass ChE 456. If you receive a grade < 60 on major 2, you will be required to repeat the second major. Satisfactory completion of the repeated major will earn you a grade of 60 for the second major.

3 Final Exam — There will be a mandatory meeting with Dr. Dadyburjor for the entire class during the regularly scheduled final exam time for ChE 456. Attendance is required in order to receive a grade for ChE 456.

The design project grade for each student will be recommended to the instructors by the Chief Engineer in consultation with Group Leaders. Any grade may be increased or decreased by the instructors by a maximum of one letter grade. The instructors will assign the grade for the Chief Engineer. Each member of the class will be allowed to review the grade given to him or her by the Group Leader/Chief Engineer. Formal, written agreement and/or rebuttal by both grader and gradee are required before grades are submitted to the Instructors.

Attendance:

Attendance at and participation in all class meetings is expected. ***One point will be deducted from your final grade for each unexcused absence. One point will be deducted from your final grade for three late arrivals.*** Attendance at Q & A and major reviews will be considered part of the grade for each Major. One increment (2.5 points) may be deducted per absence. Attendance at all of your group's presentations is required. Attendance at the end-of-semester and end-of-year presentation is also required. This is part of the grade for the project as recommended by your chief engineer. Any proposed absences must be discussed with the instructors and/or chief engineer in advance.

For certain classes, absence will require an additional assignment, which may take longer to complete than the length of the missed class. Certain group activities cannot be fully tested and must be experienced. The dates of these classes will be announced in advance

and are marked with an * on the syllabus that follows. It is possible that class rescheduling due to faculty travel schedules may change these dates. Job interviews and other non-University-sanctioned, extra-curricular activities are not necessarily sufficient reasons for absence.

There will be an exit interview with the Department Chair during the final exam time for CHE 456 in the spring semester. Attendance is required in order to receive a passing grade in CHE 456.

There are three categories of instruction used in this course. These are discussed in the next three sections.

1. Classroom

The classroom portion of this course will mostly be devoted to problem solving exercises involving design and performance of chemical processes, engineering economics, safety, and ethics and professionalism. The approximate day-to-day schedule is on the following page.

2. The Design Project

Beginning on the first day of class (Tuesday, August 24, 2010) and continuing through the last day (Thursday, April 28, 2011), you will be working on a comprehensive chemical engineering design project.

Organization:

You will learn to work on a large team on a complex problem. Your Chief Engineer will either be Nathaniel Guy or Jennifer Wiegand. They will develop the group structure in consultation with the instructors. It is your responsibility to tell your Chief Engineer and the instructors of any problems that you observe in the group effort, even if these problems appear to be outside your specific assignment on the project.

Milestones:

Midterm Presentation
Tuesday, October 5 or Thursday, October 7, 2010

First Semester Presentation (open to the entire College community as well as selected others)
Tuesday, December 7 or Thursday, December 9, 2010

Midterm Presentation
Tuesday, March 1 or Thursday, March 3, 2011

Final Year Presentation (open to the entire College community as well as selected others)
Tuesday, April 26 or Thursday, April 28, 2011

Approximate Syllabus			
Class	**Date**	**Topic**	**Chapter**
1	8/24	Introduction, Assessment exercise, Approximate calculations	
2	8/26	Problem solving strategies, flowsheets	1
3	8/31	Hierarchical approach to process design	2
4	9/1	Batch Operations	3
5	9/7	Batch Operations	
6	9/9	Understanding process conditions, Design heuristics	6, 11
7	9/14	Pump and compressor performance	18, 19
8	9/16	Pump and compressor performance Heat exchanger design and performance	 18, 19
9	9/21	Heat exchanger design and performance	
10	9/23	Separator design and performance	18, 19
11	9/28	Separator design and performance Reactor design and performance	 20
12	9/30	Reactor design and performance	
13	10/5	Troubleshooting problems	22
14	10/7	Capital cost estimation	7
15	10/12	**Midterm Exam**	
16	10/14	Manufacturing cost estimation	8
17	10/19	Time value of money Ethics and professionalism* (in afternoon)	9 23
18	10/21	Time value of money Ethics and professionalism* (in afternoon)	
19	10/26	Economic Profitability Major #1 Q & A in afternoon	10
20	10/28	Economic profitability	
21	11/2	No class – election day	
22	11/4	Economic profitability	
23	11/9	Optimization	14
24	11/11	Heat exchanger networks	15
25	11/16	Heat exchanger networks	
26	11/18	Heat exchanger networks	
27	11/30	Major #1 review	
28	12/2	Major #1 review	
29	12/7	Safety*	24
30	12/9	Safety*	
	12/14	**Final Exam 15:00-17:00**	

3. The Majors

Two individual design projects will be assigned during the year. You will be given a fixed period of time to do each problem. You must do each problem without any help of any kind from any other person. This is your opportunity to develop and to display your individual design and problem-solving skills. You will prepare a written report on each project. An extremely important part of the learning process will be your meeting with the instructors, at which time you will explain and defend your work and receive personalized feedback from the instructors. Many of our graduates have indicated that they learned more in these (nominally one-hour) orals than in the rest of their four years. A class discussion and review will follow each of the Majors.

Schedule:

Major 1 distributed	10/22/10
Major 1 question and answer session	10/26/10
Major 1 due	11/15/10
Major 1 orals	11/15/10-11/19/10
Major 1 review begins	11/30/10
Major 2 distributed	1/21/11
Major 2 question and answer session	1/25/11
Major 2 due	2/21/11
Major 2 orals	2/21/11-2/25/11
Major 2 review	3/8/11

Grading Rubric for Majors:

There are four components, roughly equally weighted:

- technical content
- oral presentation
- response to questions after presentation
- written report

A work

technical content

- responds fully to assignment
- is free of significant technical errors
- provides supporting arguments and evidence
- maintains a level of excellence and shows originality and/or creativity in solution

response to questions

- answers to questions demonstrate clear knowledge and an understanding of problem

oral presentation and written report

- expresses purpose of assignment clearly and persuasively
- begins and ends effectively
- is well-organized and unified

uses appropriate, direct language
correctly acknowledges and documents sources
is free of errors in grammar, punctuation, word choice, spelling, and format
makes effective use of visual aids, figures, tables, etc.

B work

similar to A work but:
does not demonstrate originality and/or creativity
contains minor technical errors
demonstrates originality and/or creativity but flaws in oral presentation or written report

C work

demonstrates overall competence but contains technical errors, omissions, and/or flaws
no originality and/or creativity
flaws in oral presentation and written report
does not respond well to all questions

D work

some aspects done correctly and/or some valid response to questions
significant errors, omissions, and/or flaws both technically and in communication aspects
response to questions demonstrates significant gaps in knowledge and understanding

F work

major errors, omissions, and/or flaws both technically and/or in communication aspects
unable to answer most questions
unable to explain and/or justify what was done
demonstrates significant lack of knowledge and understanding