Department of Chemical and Environmental Engineering
The University of Arizona
Fall 2015

ChEE 442
"Chemical Engineering Design Principles"

Tuesday/Thursday 12:30-1:45 p.m.
BioSciences West Room 301

Syllabus

(The information contained in this syllabus is subject to change.)

Instructor: Prof. Glenn Schrader
Email: schrader@email.arizona.edu
Office: Harshbarger 16B (west side of building, lower level, inner office)
Phone: 520-621-6597 (no voice mail)
Office hours: Monday 10-11 a.m. and Thursday 1:30-3:30 p.m. (through email appointment)

TA: Elham Ebrahimiaqda
ebrahimiaqda.arizona.edu
Harshbarger 112
Office hours: Monday 3-5 p.m. (through email appointment)

Textbook (required for ChEE 442 and 443):
Process and Product Design Principles, W.D. Seider, J. D. Seader, D. R. Lewin, and S. Widagdo, 3rd Edition, 2009, Wiley and Sons.

Course Website:
D2L website for ChEE 442

Aspen or CHEMCAD Access:
ChEE 442 will either use Aspen or CHEMCAD: watch for further information.
Aspen instructions will be provided later during the semester.
Current instructions for CHEMCAD can be found at:
https://support.engr.arizona.edu/faqs/chemcad_off_campus.pdf.
For further technical assistance, contact Seth Gilchrist at sgilchrist@arizona.edu.

Course Description:
This course will introduce you to the fundamental principles of chemical process design with an emphasis on synthesis, integration and system-level understanding. It will equip you with heuristic techniques important in process conceptualization, including the evaluation of chemical processing alternatives, utilization of fundamental industrial chemistry and biochemistry, thermodynamic constraints, applied kinetics, reactor selection, separation strategies, environmental-safety-health (ESH) concerns, and economics You will also be expected to include consideration of "green chemical engineering" design principles to mitigate environmental impacts of processing operations and to promote the practice of more sustainable engineering options. The course will give you experience in the application of these techniques to practical process-related problems. This course offers an important opportunity to gain experience working with teams and communicating through written and oral formats. Professionalism, ethics and life-long learning will be important components of the course.

Course Objectives (ABET):
Upon completion of this course, students should be able to:
1) Implement and integrate material from previous courses in order to synthesize the understanding of fundamental chemical processing phenomena in order to conceptualize process designs: specifically, ChEE 201, 202, 203, 303, 305, and 326. Additional material from ChEE 420 will be utilized as the semester progresses.
2) Evaluate the basic economic aspects of chemical processes.
3) Use Aspen, CHEMCAD, or similar simulation tools to model and evaluate various chemical processes and to be able to verify the calculations are correct.
4) Discuss the limitations, strengths, and uses of life cycle assessment methods applied to chemical engineering problems; read and critique published life cycle assessments for their individual strengths and weaknesses; implement life cycle assessment for specific chemical engineering process flowsheets; incorporate concepts of sustainable engineering practice.
5) Evaluate and improve chemical process and product designs to identify environmental impact, safety requirements, and human health constraints.
6) Write reports in various formats which meet technical specifications, demonstrate logical constructs, and concisely convey required information.
7) Explain through oral presentations to other engineers and scientists the reasoning for specific process conceptualization as well as specific rationales (such as green chemistry and life cycle assessment methodologies); present technical material in an organized, logical and clear manner.
8) Obtain specific information in the published literature and to evaluate the relevance of the materials; use library and other resources efficiently and ethically.
9) Work effectively in teams, identify and rectify team conflicts, and evaluate performance accurately and honestly.
10) Identify ethical violations in the (current) academic and (future) work environment; develop the basis for professional conduct.
11) Self-address personal difficulties for solving complex problems and take corrective action; develop the basis for life-long learning and technical skill advancement.

ChEE 442 Classroom Contracts:

Prerequisite: You must be enrolled in/have taken ChEE 420 to be enrolled in ChEE 442.
E-Classroom Policy: Turn off all things that "beep" (e.g. phones, iPods, pagers)
Code of Student Conduct: http://deanofstudents.arizona.edu/studentcodeofconduct
Code of Academic Integrity: http://deanofstudents.arizona.edu/codeofacademicintegrity
Threatening Student Behavior: http://policy.web.arizona.edu/~policy/threatening.pdf
SALT Center: Students who are able to use the services of the Strategic Alternatives Technology Center or may have other educational needs should contact Prof. Schrader as soon as possible to discuss required accommodations. However, this must be done at least one week prior to the mid-term exam to allow for needed preparations.

Accessibility and Accommodations:
It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations.
Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Learning and Instruction Mode:
This course will be conducted using an "active" or "collaborative" learning mode (in the newest CLS classroom BSW 301) which emphasizes classroom-based activities and working in groups or teams. You may have experienced this approach in other ChEE courses, but for further information, please review the UA Office of Instruction and Assessment website:

http://aaustem.oia.arizona.edu/cls Scientific evidence points to increased overall performance for students if active learning instructional approaches are successful implemented [see the article under the STEM Education Literature tab by S. Freeman "Active learning increases student performance in science, engineering, and mathematics". *Proceedings of the National Academy of Sciences, 111*(23), 8410-8415.] There also are several books and websites that can be recommended that can help to pinpoint your inherent learning proclivity, learning cycle, and functional approaches. ChEE 442 will assist you in becoming accustomed to different learning approaches and working in various professional environments.

ChEE 442 Class Topics

(subject to change during semester)

Date	Topic	Project/Homework Assignment Date
8/25	Course Overview Professionalism/Professional Organizations Information Literacy	Homework 1
8/27	Introduction to Process Conceptualization ChE Practice: Case Study Approach Invention/Innovation: Patents/Trade Secrets	
9/1	Process Flow Diagrams I: Engineering Chemistry Green Chemistry/Sustainability	Homework 2
9/3	Process Flow Diagrams II: Thermodynamic Equilibrium Exothermic/Exothermic Reactions	
9/8	Process Flow Diagrams III: Estimation of Thermodynamic Properties Thermodynamic Feasibility	
9/10	Process Flow Diagrams IV: Industrial Chemical Kinetics Chain Reactions (Unbranched)	Homework 3
9/15	Process Flow Diagrams V: Catalytic Principles Kinetics of Catalytic Processes	
9/17	Process Flow Diagrams VI: Reactor Selection and Fixed Beds Heuristics	
9/22	Process Flow Diagrams VII: Explosions and Safety Heuristics	Homework #4
9/24	Process Flow Diagrams VIII: Human Health and Environment Heuristics	
9/29	SACHE Modules Career Fair Day	Homework #5
10/1	Process Flow Diagrams IX: Heat Exchanger Design for Networks Heuristics	Homework #6
10/6	Review of Homework Assignments	
10/8	Process Flow Diagrams X: Separations Heuristics	
10/13	Process Flow Diagrams XI: Reactors-Separator Integration Strategies	**Project 1**

10/15	Review of Process Conceptualization Project 1 Working Session	
10/20	Introduction to Triple Bottom Line Capital Costs and Estimation Techniques	
10/22	Annual Costs/Cost Accounting/Cash Flow Net Present Value	
10/27	Professional Ethics Due Diligence	Homework #7
10/29	Water Ethics Special Presentation: Fracking	Homework #8
11/3	CHEMCAD Review	
11/5	Ammonia Case Study (Ch. 13): Overview Reactor System Calculations	**Project 2**
11/10	Ammonia Case Study (Ch.13): Flashing and Distillation	
11/12	Project 2 Working Session	
11/17	Ammonia Case Study (Ch. 13) Heat Exchangers and Costing	
11/19	**Written Examination** Project 2 Initial Reviews Written and Oral Presentation Guidelines	
11/24	Project 2 Working Session VoiceThread Introduction	
12/1-3	Project 2 Working Sessions Project 1 Reviews	
12/8	Project 2 Final Submission Class Summary	

Evaluation:

(total point basis)

"A = 85-100%"	"B = 70-84%"	"C = 50-69%"	"D = 40-49%"	"E < 40%"
Homework		**20%**		
Projects [technical and written components]		**50%** Project 1: 15% Project 2: 35%		
Midterm Examination		**20%**		
Final Oral Presentation [for Project 2]		**10%**		

Attendance:

Since this class is being conducted in a "collaborative/active learning mode", participation in activities and experiences during the class period is an essential to fulfill the requirements for the course. Some exercises and assignments will be initiated and completed during the class period with no external activity required. Furthermore, active learning is frequently based on team efforts, so if you are absent from class, it will disrupt the functioning of the teams. Therefore, attendance is required and will be monitored. Unexcused absences will result in point deductions.

Team Projects:

Students will be assigned to teams for Project 1 (this corresponds to your seating assignments for the first day of class). New groups will be formed for Project 2, based on the outcomes for the first project. A written report is required for both projects (jointly prepared), but an oral presentation is also required for Project 2 at the end of the semester.
Teams will receive a group grade for the written reports, but students in each group may receive scores that vary from the team grade based on "peer review" by their team members and additional evaluation by the instructor. For example, if an individual in a group contributes far less (more) than other members of the group, they will receive a score below (above) the team grade given by the instructor on the design report.
Students in each group may also be given the opportunity to recommend to the instructor that a member of the group be "fired" who may then be required to work independently. Peer review forms will be used following Project 1.

Homework:
Students must work individually on homework unless informed otherwise (such as team activities). All assignments are due at the beginning of class on the due date. Late homework will not be accepted. Students have one week from the day that homework is returned to discuss grading issues. Homework that is not picked up beyond 1 week after the first day a return is attempted will likely end up in the "recycle bin".
Use 8.5 x 11 inch paper with writing on one side only. Multiple pages must be stapled together. Each page must have the student's name, the course number and the page number in the upper right hand corner. Points will be deducted for failure to meet these standards.

Midterm Examination:
A make-up examination may be arranged if you notify the instructor before the regularly-scheduled examination. A makeup examination will be scheduled only if the student has a valid reason for missing the regularly scheduled exam.