ChEE 202
Elements of Chemical Engineering II
Spring 2016
University of Arizona

Instructors: Dr. Paul Blowers
128 Harshbarger
Office Hours: To Be Scheduled as Needed
blowers@email.arizona.edu (this is the primary contact for student concerns and questions)

Dr. Kasi Kiehlbaugh
132 Harshbarger
Office Hours: To Be Scheduled as Needed
(do not email)

Lecture: MWF 12:00 pm – 12:50 pm
BioSciences West 301

TA: Jaewook Choi

Course Description:
This course will introduce you to the fundamental principles of chemical process analysis. It will equip you with problem-solving techniques and will give you experience in the application of these techniques to a wide variety of process-related problems. This course will also begin demonstrating how mathematics and spreadsheets can be a fundamental tool for solving complex engineering problems, including the solving of transient material and energy balances.

Text: *Notes of Eduardo Saez, posted to D2L*
Felder and Rousseau, any edition (same book as required for ChEE 201)

Course Objectives:
Upon completion of this course, students should:
1) be able to competently solve energy balances for both open and closed systems for pure substances and be able to apply these techniques to chemical engineering unit operations
2) be able to perform numerical integration for analyzing chemical engineering processes as required, using both Excel and Visual Basic
3) be able to perform curve fitting and develop empirical correlations using linear regression, polynomial regression, and non-linear regression, all in the context of solving chemical engineering problems.
4) be able to analyze thermodynamic properties of multicomponent mixtures as applied to separations unit operations
5) be able to perform energy balances for ideal mixture of gases and vapors, using both thermodynamic tables and psychrometric charts
6) be able to analyze heats of mixing for non-ideal mixtures for chemical engineering applications
7) be able to perform energy balances for reactive mixtures
8) be able to solve instantaneous transient material and energy balances, applying finite difference methods such as Euler's method and the Runge-Kutta method, including handling of mixtures
9) be able to perform energy calculations on chemical engineering processes with entropic considerations (i.e., compression and pressure drops through valves) and model simple thermodynamic cycles.

Course Prerequisites:
The courses you must have taken before this course are:
MATH 223, ChEE 201 and 201L. If you have not completed the co- or prerequisite courses, you may be dropped from the course at the instructor's discretion as you may not succeed based on past student performance. Math 254 is a co-requisite.

Course Website: D2L website for ChEE 202.

Important Dates to Keep in Mind:
Last day to use UAccess to add or change classes: January 21, 2016.
Last day to drop a course where it will not appear on the record of enrollment: January 27, 2016.
Last day to withdraw from a class online through UAccess with a "W": March 29, 2016. Students must be passing the course in order to withdraw at this time.
Last day to withdraw with a Dean's signature, for extenuating circumstances: April 19, 2016.

Course Grading Policies:
Pre-Class Quizzes (10 % of grade)
Research has shown consistently that students who do preparatory work prior to a class meeting, such as learning definitions, attempting a problem, or organizing information, do substantially better than students who do not. This does not imply more work, but shifting work to being more pro-active instead of working harder after the fact to get caught up with the new content. To highlight the importance of the preparatory activities, short pre-recordings will introduce the difficult points where students struggle with the content, which will be followed by suggested reading content in both the primary and secondary texts, and then capped by a pre-lecture quiz in D2L. Students can take each quiz three times, and these quizzes cumulatively contribute 10 % to the total class grade.

Class Attendance (10 % of grade)
Class attendance is not optional for this class. Unlike some classes where students passively copy notes, the activities done in class are critical to student success. Class attendance will be verified with a clicker question that appears at some point randomly in the day's activities and will be auto-recorded through that device. If you do not have a clicker, please get one as quickly as possible from the UA Bookstore. Clickers will also be used to gauge understanding of reading material, support class discussions, facilitate understanding of new concepts and review previously taught material.

Homework Assignments (15 % of grade)
Homework is due at the beginning of the class on the day it is due. Late homework will not be accepted. Homework will be done in groups and submitted to the group dropbox for each assignment on the day it is due. The submitter is responsible for reporting if any group member did not participate in a meaningful way to creating the group solution. Students who do not participate will not receive full credit. For instance, a group could report that a member helped on ¼ of the problems and didn't show up to meetings or comment by email, and that student would then receive only ¼ of the group grade.

Midterm Exams (2 exams, 30 % of grade total with 15 % each).
These in-class exams are **comprehensive,** and the scheduled dates can be found at the end of this document. These exams will require students to make a concept map of the major and minor topics of the class for up to five points of credit toward the exam. These exams will also be open book, with students allowed to write anything they want in the blank spaces in their Felder and Rousseau books. We tried an experiment in ChEE 201 during the fall semester of allowing students to listen to music on headphones during the exam to block out distracting noises and to stay relaxed. We will allow this again this semester.

Make-up exams: A make-up exam may be arranged if you notify the instructor designated for email contact before the regularly scheduled exam. A make-up exam will be scheduled only if the student has a valid reason for missing the regularly scheduled exam. Verifiable illness with notification from the emergency dean or documentable family emergencies are valid reasons for missing an exam.

Supplemental Class Meeting Attendance and Completion of Work (10 % of grade)
Supplemental sessions will meet weekly during the semester, and all students will be expected to participate fully. Attendance will again be kept using auto-grading clicker questions, so make sure to have you clicker with you in these meetings. The supplemental meetings will be used to work in small teams on the homework that is due the following week. You will then be able to take those results/ideas back to your main section team from class, which is the team you will complete and submit homework with. This approach of working with two different groups on the same problems is going to be done to foster peer-to-peer learning and allow students to solve more complicated problems with additional support. If the TA determines that some students are not participating, even when present, then peer evaluations may be used to allocate attendance grades.

Final exam: (25 % of grade).

Comprehensive final on Wednesday, 5-11-16, during the regularly scheduled final time, which is 10:30 am until 12:30 pm in the normal classroom.

Grading Rubric:
Letter grades on exams or assignments will not be determined; a final letter grade will be given at the end of the semester instead. This course will be graded on a straight scale as follows:

Total percentage of points earned	Final Grade
90-100 %	A
80 – 89.99999 %	B
70 – 79.99999 %	C
60 – 69.99999 %	D
< 60 %	E

Other Course Policies: Pagers/telephones or other communication technologies used for personal use rather than assigned class activities are strongly discouraged. Students who disrupt class or learning activities will be asked to leave the classroom.

Plagiarism and Academic Dishonesty: Although this course is not writing intensive, plagiarism in any form, including copying the work of another student, is strongly discouraged. The plagiarism policies within the Student Code of Academic Integrity will be strictly followed: https://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity. Clicking in for another person is a form of academic dishonesty and will be dealt with according to the same guidelines.

Threatening Behavior: The general policies against threatening behavior by students will be followed: http://policy.web.arizona.edu/education-and-student-affairs/threatening-behavior-students

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 the regular lecture and supplemental classrooms should remain available for students who find that standard classroom seating is not usable.

SALT Center and Disability Resource Center: Students who are able to use the services of the Strategic Alternative Learning Techniques Center or may have other educational needs may see the professors at any time to discuss accommodations for their needs. However, this should be done at least one week prior to the first exam to allow for preparations that may be needed.

Standards for Homework Problems and Quizzes:
1. Briefly restate the problem using a sketch or diagram where appropriate. Label the sketch or diagram with all quantities involved.
2. Indicate the basis you select, and indicate any change of basis within the problem. State assumptions.
3. Include both the numerical value and units for all quantities involved, including intermediate results.
4. Answers should be circled or otherwise marked and reported to an appropriate number of significant digits.
5. Values obtained from a handbook or other reference should be accompanied by a citation. For example:

CCl_4 boiling pt. 76.5 °C (CRC, pg C-373)

6. Show how you have checked your work if appropriate.
7. Be clear and concise when writing answers to questions.

Standards for Style and Presentation of Problem Sets

1. All assignments are to be submitted either physically on 8.5 x 11 inch paper with writing on one side only or via the appropriate D2L dropbox. Multiple pages must be stapled together. Unlined paper may be used if the work is done neatly. Handwriting must be legible.
2. Each page must have the students' names and group number, the course number and the page number in the upper right-hand corner.

Substandard work will result in a loss of credit.

Required Extracurricular Activities: none

Special Materials Required for the Class: See online course content.

Changes to the Syllabus: The information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advanced notice as deemed appropriate by the instructors.

Class Schedule: (note: section numbers may not match your edition of the book, but topics will)

Week	Lec. No.	Date	Day	Pre Lecture Recording	Reading Assigned for this Day from Felder and Rousseau (3rd edition)	Reading Assigned for this Day From Typed Notes	Pre Lecture Quiz	Due Dates	Topic
1	1	1-13	W		None	None	None		Review of ChEE 201
	2	1-15	F	2	Sections 7.0-7.1	None	2		
2		1-18	M			Pg 1-12			No class-MLK
	3	1-20	W	3	Section 7.2		3		Kinetic and Potential Energy, First Law of Thermo
	4	1-22	F	4	Section 7.3		4		Closed System Balances
3	5	1-25	M	5	Section 7.4	Pages 13-24 Steam Table Slides	5	HW 1	Open System Balance and Intensive Variables
	6	1-27	W	6	Section 7.5		6		Steam Tables
	7	1-29	F	7	N/A		7		Clapeyron Equation, C_p, C_v
4	8	2-1	M	8	Section 8.1-8.2	Pages 25-29	8	HW 2	Heat Capacities
	9	2-3	W	9	N/A		9		Math: Curve Fitting
	10	2-5	F	10	N/A		10		Math: R^2 Values
5	11	2-8	M	11	NA	Lecture Notes Online 9-10	11	HW 3	Math: Linear Regression
	12	2-10	W	12	Section 7.6		12		EB: Compressors
	13	2-12	F	13	Section 8.3		13		EB: Heat Exchanger
6	14	2-15	M	14	Section 8.4a-c	Pages 29-32	14	HW4	EB: Adiabatic and Isothermal Tank Filling
	15	2-17	W	15	Section 7.7		15		Problem Solving: 7.31b, 7.35a
	16	2-19	F	16	Section 7.8		16		Mechanical Energy Balances
7	17	2-22	M	17	Section 8.6	Pages 33-39		Midterm 1	State Functions/Energy Pathways: 8.25
	18	2-24	W	18			18		H and U at Constant T
	19	2-26	F	19	N/A		19		Math: Numerical Integration
8	20	2-29	M	20		Pages 54-59	20		Heat Capacities of Mixtures
	21	3-2	W	21			21		Problem Solving: 8.31
	22	3-4	F	22	8.4d		22		Psychrometric Chart
9	23	3-7	M	23		Pages 68-72	23	HW 5	
	24	3-9	W	24			24		Dehumidifiers
	25	3-11	F	25			25		Problem Solving: 6.28
		3-12 to 3-20				Spring Break – No Class			
10	26	3-21	M	26	Section 8.5	Pages 77-88	26	HW6	Non-Ideal Mixtures

	27	3-23	W	27	Section 9.1-9.2		27		Energy Balance With Reactions
	28	3-25	F	28	Section 9.3-9.4		28		
11	29	3-28	M	29	Section 9.5a	Pages 89-94	29	HW 7	Complex Energy Balances
	30	3-30	W	30	Section 9.5b		30		Thermodynamic Pathways and Reference States
	31	4-1	F	31	Section 9.6		31		
12	32	4-4	M	32	Section 9.7	Pages 94-100		Midterm 2	Problem Solving: 9.56
	33	4-6	W	33	Section 10.2-10.2		33		Transient Balances Introduction
	34	4-8	F	34	Section 10.3		34		
13	35	4-11	M	35		Lecture Notes Online 34-35	35		Transient Heat Balances
	36	4-13	W	36			36		3D Balances
	37	4-15	F	37	Section 10.4		37		Simultaneous Balances
14	38	4-18	M	38		Lecture Notes Online 39	38	HW 8	Checking Understanding with Example
	39	4-20	W	39	Section 10.5		39		More Simultaneous Balances
	40	4-22	F	40			40		
15	41	4-25	M	41		Wrapping Up the Lectures	41	HW 9	Problem Solving Examples
	42	4-27	W	42	Posted Notes and pdfs from other sources		42		Thermodynamics and Entropy
	43	4-29	F	43			43		
16	44	5-2	M	44	Solve Prior Final Exam	Self-reflection and Review	44	HW 10	
	45	5-4	W	45	Solve Prior Final Exam II	Last Day of Classes		Class Evaluation	