ChEE 326
Chemical and Physical Equilibrium
Spring 2018
University of Arizona

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Active Learning Environment: MWF 11:00 – 11:50 am Bio. Sciences West 301

Preceptors:
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Instructional Manager: Ryan Yoha (ryanyoha@email.arizona.edu)
This person is who you email if you have clicker issues, if you miss the dropbox for an assignment, if there is an emergency, if you have issues outside of homework or exams. They will do a first response.

Course Description:

This course will introduce you to the fundamental principles of chemical process equilibrium 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.

Text: *Introductory Chemical Engineering Thermodynamics*. J. Richard Elliott and Carl T. Lira, second edition, ISBN 978-0-13-606854-9

Elementary Principles of Chemical Processes, 4th Edition, R. M. Felder and R. W. Rousseau, John Wiley and Sons, 1998 or 2005.
(Same Textbook used for ChEE 201)

Communicating With the Teaching Team Online:
Piazza will be used for all questions and students should obtain a free account at piazza.com and then be able to link to our class. Students who answer questions will earn up to 2% extra credit towards their final grade. Before asking a question, please check that someone has not already asked/answered the same question. Preceptors will also be monitoring the piazza discussions and commenting. You can join the discussion board here: http://piazza.com/arizona/spring2018/chee326

Course Objectives:
Upon completion of this course, students should:
1) be able to solve thermodynamics problems using both hand and computer programming techniques, building on ChEE 201, 202, 203, and 303.
2) be able to apply fugacity to estimate ideal and non-ideal properties of substances
3) be able to construct phase diagrams for ideal and real mixtures of gases, liquids, and solids
4) be able to construct and use a model of phase behavior using limited experimental data for VLE, LLE, and SLE

5) be able to formulate and solve chemical reaction equilibrium calculations that may include multiple reactions
6) be able to use ASPEN to simulate various equilibrium processes and to be able to verify the simulated results are correct

Other metaconcepts the students should be proficient at:
1) be able to comfortably organize and present group or individual material to the class
2) be able to add equilibrium thermodynamic knowledge to your existing framework of chemical engineering problem solving techniques
3) be able to identify personal difficulties during problem solving and to take corrective action
4) be able to knowledgeably think of everyday examples where equilibria are important
5) be able to search for and use information from published sources

Course Prerequisites:
The courses you must have taken before this course are ChEE 303 and CHEM 480a.

Course Website: D2L website for ChEE 326

Important Dates to Keep in Mind:
All dates and deadlines regarding registration, dropping, GRO'ing, etc. can be found at https://www.registrar.arizona.edu/courses/dates-deadlines

Course Grading Policies:
This section details the graded elements of the class, first in a big picture way and then in detail.
Big Picture View of Graded Elements

Individual	HW	due weekly	15%
Group	HW	due weekly	5%
Pre-Class Quizzes		due daily	10%
Attendance		due daily	10%
Midterm		Exams four times/sem	40%
Final Project		end of semester	10%
Final Exam		end of semester	10%
Total			100%

Teamwork is required in all engineering jobs and we will start building your skills in this area by working in teams inside and outside of class. You should help your classmates master content even as you ask questions of them when you are stuck. To help your team, make sure you attend class, do the pre-quizzes, and work with them. You will find that the group homework will not be solvable by one person so certainly work with your team on those activities.

Homework: (15% of grade for individual problems + 5% for group team problems)
Individual homework is due at the ***beginning*** of the class on the day it is due to the dropbox for that day. Late homework will not be accepted. A clear scan, picture from your device, or other clear materials will be acceptable. Each week, one problem will be graded for detail and will make up the bulk of the points for the individual homework grade, while the other problems will be assessed for completion and be worth 10% each for making a good attempt. The problem graded in detail will be selected at random from the week's set of cumulative problems.

Group HW will be due once a week and will typically be the one or two toughest problems from each set of concepts will be due each week and is a group mastery problem that you will solve together in your

learning teams. Your team should submit only one single copy to a team member's dropbox before class on the day that set is due. These problems will be graded for detail.

Also, the group presentations in class will be a part of the 5% for group homework. For more information, visit the course site.

To eliminate confusion and difficulties in staying current, students will have 1 week from the date homework, quizzes, or exams are returned to discuss grading criteria and scores with the instructor or regrader. After the 1 week time limit has passed, students will not be able to petition for changes to their grade. All regrade requests must be done through the Regrade Form posted on the d2L site.

Pre-class Quizzes on D2L: (10% of grade)
There are many elements of being ready for new topics and part of that is to do the class readings ahead of time so you are ready for what happens in class. The online quizzes developed to help you be ready for class will make up 10 % of the grade and you will have three attempts on each quiz and your highest score will be the one recorded. These quizzes are designed so students will know the most important details from each reading section. If you want to efficiently study, open the quiz and start reading, looking for the details the questions ask you to notice, and take notes on the details. You'll quickly find out that the quizzes are randomized and if you are unhappy with your score and retake, that you get a new set of questions that cover the same content in a slightly different way. You'll be faster if you take the quiz seriously the first time.

Attendance (10% of grade)
An active learning environment involves everyone working together to help master the content. Points will be assigned for attendance for each lecture based on use of your clicker/responseware during class, but up to two missed days will be dropped for each student. If you were present on a day in class and did not have your clicker, email a scan of your notes to that day to the attendance preceptor, clearly telling them which lecture number the notes are for and which date.
All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion; the Panopto recording will need to be watched and the attendance preceptor emailed to earn the credit. The complete list of UA approved holidays is available at: http://registrar.arizona.edu/calendar-religious-holidays Absences pre-approved by the UA Dean of Students are also honored, but the Panopto recording will need to be watched and the attendance preceptor emailed to earn the credit.

Exams (four exams, 10% each, 40% of grade total).
These in-class exams are **comprehensive** and are scheduled on later pages. Unless otherwise announced, these exams will be open book. The exams will have three pieces:
A group exam that will be paper and Excel-based (30 minutes)
An individual exam that has two parts (20 minutes)

- Calculational: you can earn partial credit on your individual solution
- Conceptual: If you score below 70% on this, then this becomes a multiplier for your group exam grade, i.e., if you get a 60% on this, your group exam grade would be the score of the team times 0.6

Make-up exams: There will be no make up exams. If a student has a valid medical or emergency excuse, the missed exam grade will be replaced by the average of the other midterm grades.

Final Project: (10% of grade):
Due with two separate pieces at the end of the semester.
Four people will be assigned per team. See content on course site for more information.

Final exam: (10% of grade).
The comprehensive final is schedule to be on Monday May 7, 10:30 am to 12:00 pm.

Extra credit: (up to 1% increase in final grade)
Students who answer other students' questions posted to the piazza discussion board can earn up to 1% extra credit towards their final course grade, at the discretion of the instructor.

Possibility of Dropping some Scores Based on Class TCE Response Rates:
If 80% of the class completes the Teacher Course Evaluation at the end of the semester, then the lowest two pre-quiz D2L grades will be dropped for every student in the class.
If 90% of the class completes the Teacher Course Evaluation at the end of the semester, then the lowest individual HW score will be dropped.

Plagiarism: Although this course is not writing intensive, plagiarism is unacceptable. The plagiarism policies within the Student Code of Academic Integrity will be strictly followed: http://doc.web.arizona.edu/uapolicies.

Threatening Behavior: The general policies against threatening behavior by students will be followed: http://policy.web.arizona.edu/~policy/threaten.shtml

Inclusivity: This course supports elective gender pronoun use and self-identification; rosters indicating such choices will be updated throughout the semester, upon student request. As the course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect

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
78 – 89.999 %	B
66 – 77.999 %	C
54 – 65.999 %	D
< 54.999%	E

Course Lectures and Attendance Policies:
Telephones/electronic devices, or other communication technologies are strongly discouraged unless used for legitimate learning purposes, like finding information to solve a problem assigned in class. Students who disrupt class or learning activities will be asked to leave the classroom.

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, 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

SALT Center and Disabililty Resource Center: Students who are able to use the services of the Strategic Alternatives Technology Center or may have other educational needs may see the professor at any time to discuss accommodations for their needs. However, this should be done at least 1 week prior

to the first exam to allow for preparations that may be needed. Students who are registered with the Disability Resource Center must submit appropriate documentation to the instructor if they are requesting reasonable accommodations: http://drc.arizona.edu/teach/syllabus-statement.html.

Student Success in This Course

Students who succeed in this class, i.e., those who earn grades of A or B, typically are serious students who follow the Arizona Board of Regents policy of studying three hours for every in class hour. This means that you should expect to spend 9-10 hours of outside time on this class each week, consistently, throughout the semester. This means:

1) Students should attend class for all scheduled lecture periods and get notes from classmates when they are unable to attend.
2) Students will often be referring to the book during class so you should make sure you have an electronic or bound version of the book in class.
3) Students should come to class prepared to participate in active learning methods that encourage them to explore and question the material they are learning. This means that students should not expect any time during class for other activities like text messaging, telephone calls, other courses, or activities not part of the class. An active learning environment like the one used in the class maximizes exposure to problem solving techniques and mastery of the information.
4) Students should do their homework in a timely manner. Most homework assignments will be covered in class approximately three to five days in advance of when they are due. This leaves students ample time to reflect on the examples in class, come to office hours, and submit complete and correct homework solutions. Students should begin working on their solutions as soon as the topics are covered in the active learning lectures so they have time to reach the correct answer.

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 ^oC (CRC, pg C-373)

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

Substandard work will result in a loss of credit.

Standards for Style and Presentation of Problem Sets:

1. All assignments are to be submitted either physical 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 instructor.

ChEE 326 Spring 2018 Class Schedule (subject to change - check D2L for updates)

Week	Lec #	Date	Day	Reading Assigned	Homework Due	Pre Class Activities	Topic
1	1	1-10	W	None			Importance of this Class to ChEE
	2	1-12	F	Sec 6.0-6.2		PL2 Quiz	Generalized equations for any fluid
2		1-15	M	MLK Day – No Class			
	3	1-17	W	Sec 7.0-7.5	HW 1	PL3 Quiz	PVT and EOS
	4	1-19	F	Sec 7.6		PL4 Quiz	Solving cubic EOS
3	5	1-22	M	Sec 8.0-8.10		PL5 Quiz	Departure functions
	6	1-24	W	Sec 9.0- 9.3	HW 2	PL6 Quiz	Phase eq. – pure component
	7	1-26	F	Sec 9.4-9.7		PL7 Quiz	Gas phase fugacity
4	8	1-29	M	Sec 9.8-9.9		PL8 Quiz	Liquid and solid phase fugacity
	9	1-31	W	Sec 9.10-9.13	HW 3	No Quiz	Satn from EOS
	10	2-2	F		Test 1	No Quiz	
5	11	2-5	M	Sec 10.0-10.2		PL 11 Quiz	
	12	2-7	W	Sec 10.3-10.4	HW 4	PL 12 Quiz	
	13	2-9	F			PL 13 Quiz	
6	14	2-12	M			PL 14 Quiz	
	15	2-14	W	Sec 10.5-10.8	HW 5	PL 15 Quiz	
	16	2-16	F	Sec 10.9-10.13		PL 16 Quiz	
7	17	2-19	M			PL 17 Quiz	
	18	2-21	W		HW 6	PL 18 Quiz	
	19	2-23	F	Sec 11.0-11.2		No Quiz	
8	20	2-26	M	Sec 11.3-11.5	Test 2	No Quiz	
	21	2-28	W			PL 21 Quiz	
	22	3-2	F	Sec 11.6-11.7		No quiz	

		3-5 to 3-9	Spring Break – No Class				
9	23	3-12	M	Sec 11.8-11.10		No Quiz	
	24	3-14	W		HW 7	PL 24 Quiz	
	25	3-16	F	Sec 12.0-12.3		PL 25 Quiz	
10	26	3-19	M	Sec 12.4		No Quiz	
	27	3-21	W			No Quiz	
	28	3-23	F	Sec 13.0-13.2		PL 28 Quiz	
11	29	3-26	M	Sec 13.3-13.5		PL 29 Quiz	
	30	3-28	W		HW 8	PL 30 Quiz	
	31	3-30	F	Sec 14.0-14.9		PL 31 Quiz	
12	32	4-2	M	Sec 14.10-14.11	Test 3	PL 32 Quiz	
	33	4-4	W		HW 9	PL 33 Quiz	
	34	4-6	F	Sec 15.0-15.2		No Quiz	
13	35	4-9	M	Sec 15.3-15.6		No Quiz	
	36	4-11	W		HW 10	No Quiz	
	37	4-13	F	Sec 17.0-17.5		PL 37 Quiz	
14	38	4-16	M	Sec 17.6-17.9		PL 38 Quiz	
	39	4-18	W			No Quiz	
	40	4-20	F	Sec 17.10-17.14	Project Part 1	No Quiz	
15	41	4-23	M	Sec 17.15-17.20	Test 4	PL 41 Quiz	
	42	4-25	W			PL 42 Quiz	
	43	4-27	F			No Quiz	
16	44	4-30	M	Review for Final	Project Part 2	No Quiz	
	45	5-2	W	Review for Final		No Quiz	

All homework is due on the days listed above unless otherwise designated on a specific problem handout.