CBE:5110 Intermediate Thermodynamics
Syllabus
Fall 2019

Instructor: Charles Stanier; 4122 SC; 335-1399; email: charles-stanier@uiowa.edu
                       Office hours: TBA after student poll on availability

Textbook: Tester and Modell, *Thermodynamics and Its Applications*, 3rd ed., Prentice Hall, 1997.

Supplemental textbooks:

Think Python, 2nd edition by Allen Downey. (It is a free well-known book that has been used by many people and courses. Free HTML and downloadable PDF versions are available at thinkpython2.com. You can purchase a printed version at Amazon).

Connors, Kenneth A., Thermodynamics of Pharmaceutical Systems. Wiley Interscience, 2002.

Python Programming and Visualization for Scientists, By Alex DeCaria. Sundog Publishing, Madison, WI, 2016.

Catalog Description: Fundamental principles of thermodynamics as applied to phase equilibrium; properties of fluids, first and second law, variable composition systems, behavior of real fluids, mathematical techniques for solution thermodynamics.

Expanded Description:

Intermediate Thermodynamics reviews the principles of thermodynamics and then concentrates on applying them to real world problems. The chief objective of this course is to further develop the foundation of thermodynamics and to apply this knowledge to the solution of problems of interest to the engineer. The objective of this course is for the student to gain an enhanced understanding of thermodynamics and to gain confidence in their ability to use thermodynamics as a tool. This course assumes that you have already had an introductory course in engineering thermodynamics. In addition, we will learn to perform more rigorous and realistic calculations using the appropriate computer packages.

There will be two two-hour exams and a final. They (except the final) will be held in class and will typically comprise three problems based on the indicated material. The final exam will be comprehensive, covering the whole course with particular emphasis placed on the material since the second exam.

Learning Objectives:

- Students will be able to apply the first and second laws of thermodynamics to open, closed, and isolated systems.
- Students will be able to use modern computer tools (i.e., Python with thermodynamic libraries for pure component properties and activity coefficients) to solve non-ideal phase and reaction equilibria problems.
- Students will be able to determine identify and look up or calculate thermodynamics properties relevant to problem solving (i.e., vapor pressures, specific volumes, chemical potential, Gibbs energy or enthalpy of formation, activity coefficients).

- Students will be able to manipulate equations with thermodynamic variables, for example expressing changes in enthalpy as functions of measurable variables
- Students will be able to solve phase equilibrium problems for realistic covalent and ionic systems
- Students will be able to formulate and solve reaction equilibrium problems.
- Students will be able to relate thermodynamics principles to interfacial phenomenon such as surface tension and adsorption.

Grading:

The distribution of points for grading is indicated below.

Exam I	200
Exam II	250
Final Exam	250
Homework	300
TOTAL	1000

Conversion from points to letter grades will done by Dr. Stanier. The adjustment is such that final grades will be equal to the conversion below, or more generous. (values on 0-100% scale). Dr. Stanier does use + and – modifiers to A, B and C grades, but not to D grades.

> 90 = A   77-89 = B   63-76 = C   45-62 = D

Homework:

Homework will be due at the beginning of class on the due date. Late homework will not be accepted without prior approval of the instructor, and a penalty may be applied.

Office Hours:

Office hours will be announced via ICON / course website.

Tentative Lecture Schedule

Lecture		Date	Topic	Readings	Notes	HW
1	M	Aug. 26	Introduction	Chapt. 1-2	1-5	
2	W	Aug. 28	1st Law	Chapt. 3	6-12	
3	F	Aug. 30	1st Law		13-19	
4	M	Sept 2	No Class			
5	W	Sept 4	2nd Law	Chapt. 4	20-23	
6	F	Sept. 6	2nd Law		24-29	3-2,**3***,12,14
	M	Sept. 9	labor day – no class			
7	W	Sept. 11	2nd Law - Calc of Thermodynamics	Chapt. 5	30-35	
8	F	Sept. 13	Calculus of Thermodynamics		36-43	1, 4-1,3,**6***
9	M	Sept. 16	Calculus of Thermodynamics		44-49	Skip 50-62
10	W	Sept. 18	Properties of Pure Materials Equations of State	Chapt. 8	63-66	
11	F	Sept. 20	Python for thermodynamics			1, 5-9,**21***
12	M	Sept. 23	Properties of Pure Materials		66-70	
13	W	Sept. 25	Properties of Pure Materials		71-76	
	W	**Sept. 25**	**Exam I (7:00 pm)**			
14	F	Sept. 27	Properties of Pure Materials Intro Stat Mech - Partition Functions		77-83	
15	M	Sept. 30	Properties of Pure Materials		84-90	
16	W	Oct 2	Properties of Pure Materials		91-94	
17	F	Oct 4	Properties of Mixtures		95-101	
18	M	Oct. 7	Properties of Mixtures		101-106	
19	W	Oct. 9	Properties of Mixtures	Chapt. 9	107-112	8-5,**mine**,15
20	F	Oct. 11	Properties of Mixtures		113-121	
21	M	Oct. 14	Properties of Mixtures		121-128	HW 5
22	W	Oct. 16	Properties of Mixtures		129-130c	
23	F	Oct. 18	Properties of Mixtures		130d-135	
24	M	Oct. 21	Phase Equilibria	Chapt. 15	139-150	
25	W	Oct. 23	Phase Equilibria		151-155	
26	F	Oct. 25	Activity Coefficient Models	Chapt. 11	156-160	HW 6
27	M	Oct. 28	Activity Coefficient Models		161-166	
28	W	Oct. 30	Aqueous Solution Thermodynamics	Chapt. 12		
29	F	Nov. 1	Aqueous Solution Thermodynamics			
30	M	Nov. 4	Aqueous Solution Thermodynamics			
31	W	Nov. 6	Chemical Equilibria	Chapt. 16	183-188	
32	F	Nov. 8	Chemical Equilibria		189-194	
*33	M	Nov. 11	Chemical Equilibria		195-200	
	T	**Nov. 12**	**Exam II (7:00 pm)**			
*34	W	Nov. 13	Chemical Equilibria			
*35	F	Nov. 15	Chemical Equilibria			
36	M	Nov. 18	Chemical Equilibria		201-205	
37	W	Nov. 20	Chemical Equilibria		206-209	
38	F	Nov. 22	Surfaces, Interfaces, and Isotherms	Connors	210-212	

				Chapt. 11		
		Nov. 25-29	**Thanksgiving Break**			
39	M	Dec. 2	Surfaces, Interfaces, and Isotherms			
40	W	Dec. 4	Surfaces, Interfaces, and Isotherms			
41	F	Dec. 6	Electrical Work, Redox and pH	Connors Chapt. 13		
42	M	Dec. 9	Electrical Work, Redox and pH			
43	W	Dec. 11	Electrical Work, Redox and pH			
44	F	Dec. 13	Review for Final			
		Dec. 16-20	**Final Exam (time and date to be announced)**			

* AIChE Meeting

Collaboration / Academic Integrity / Academic Misconduct / Plagiarism

- Cheating on hour or final exams will result in an F in the course. Examples of cheating include but are not limited to looking at your neighbor's exam papers, discussing problems during an exam, or copying answers from another exam paper.
- Plagiarism may result in penalties up to 0 in the homework portion of the class. Lesser penalties may be used at the instructor discretion.
- Acceptable collaboration on homework is defined as working on problems together. However, each student should write out the final calculation for themselves, and calculate any quantities using their own calculator or spreadsheet. This includes the computer tools – while working together to use computer-based tools, each student should create, debug, and comment their own computer tools.
- Acceptable collaboration on Python is similar. It is extremely useful to sit at neighboring computers and to talk to one another about lines of code, syntax, errors, and results, each student should create, run, edit, and comment their own code on their own college computing account. Working on a program "together" (with one person typing and another looking over their shoulder) and then turning in two copies of the same program is not acceptable because the learning and preparation for quizzes and exams is not equal.
- Incidents of academic misconduct will be referred to the Dean's office and may result in additional penalties up to and including dismissal from the University
- This course is given by the Graduate College. This means that class policies on matters such as sanctions for academic dishonesty and appeals process are governed by the Manual of Rules and Regulations of the Graduate College.
- Use of solution manuals, online solution manuals (i.e., CHEGG) is prohibited and considered a violation of the academic integrity policy.

Attendance

- Missing examinations: University regulations require "that students be allowed to make up examinations which have been missed due to illness, religious holy days, or other unavoidable circumstances or other sponsored University activities." – please let me know prior to the exam if possible, or as soon as practical after the exam. I will work with you to assign, complete, and grade a makeup exam.

- Attendance is not graded. However, given the difficulty of the material, attendance and note taking are highly recommended. All other missed points will receive zero credit unless prior permission is given by the instructor. For cases where the absence is due to illness or unavoidable circumstances, please let the instructor know as soon as possible, and an accommodation will be decided on by the instructor. The notification of the instructor must be within 3 working days of the missed event or assignment for an accommodation to be considered.

University Counseling Service
Students are encouraged to be mindful of their mental health and seek help if they are feeling overwhelmed and/or incapable of meeting course expectations. For assistance with the class, students are encouraged to talk to their faculty member. For additional support and counseling, students are encouraged to contact The University Counseling Service (UCS) in 1950 University Capital Centre Suite or 3223 Westlawn South. Call 319.335.7294 to schedule appointments (Mon-Fri. 8AM-4:30PM). Find out more about the UCS at http://counseling.uiowa.edu. After hours, call the Johnson County Crisis Line at 319.351.0140 or 911 if you are having a mental health emergency.

Accommodations for Disabilities
The University is committed to provide an educational experience that is accessible to all students. If you have a diagnosed disability or any other condition that would impair your ability to complete the course requirements as stated above, please inform me as early in the semester as possible, but no later than two weeks prior to the scheduled activity. Students needing accommodations must register with Student Disability Services, (SDS): https://sds.studentlife.uiowa.edu/students/apply to obtain a Letter of Accommodation (LOA). The letter will specify what course accommodations are reasonable for that student. The office is located at 3015 Burge Hall, (319) 335.1462.

Sexual Harassment
Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. The University will not tolerate sexual harassment, nor will it tolerate unwelcomed behavior of a sexual nature toward members of the University community when that behavior creates an intimidating or hostile environment for employment, education, on-campus living, or participation in a University activity. As a member of the university community you have a responsibility to report concerns of sexual harassment immediately at the Office of the Sexual Misconduct Response Coordinator: https://osmrc.uiowa.edu/.

Electronic Communication
Students are responsible for official correspondences sent to their UI email address (@uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

Nondiscrimination in the Classroom
The University of Iowa is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (diversity.uiowa.edu).