Phase Chemical Equilibrium

ECH4123

Class Periods: MWF | period 9 (4:05 PM - 4:55 PM)

Location: FLG0210

Instructor:

Tony Ladd

Email Address: tladd@che.ufl.edu

Office Hours: Tuesday 4-6 PM Zoom (from Canvas)

Course Description

Application of thermodynamic principles to systems of variable composition including the study of phase and chemical equilibria (3 credits).

Course Pre-Requisites

ECH 3101 Process Thermodynamics

Course Objectives

Formulate problems involving phase and reaction equilibria as minimizations of the Gibbs free energy
Relate thermodynamic properties of mixtures to properties of pure components using activity coefficients
Calculate composition diagrams for VLE, LLE, and VLLE
Calculate equilibrium compositions of reactive species (gases)
Solve equations for phase and reaction equilibria using numerical methods.

Materials and Supply Fees

N/A

Relation to Program Outcomes (ABET):

Outcome	Coverage
1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.	High
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.	
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	
4. An ability to communicate effectively with a range of audiences	
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of	

engineering solutions in global, economic, environmental, and societal contexts.	
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.	Medium
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not part of the course.

Recommended Textbooks and Software *Essential Thermodynamics*, by A.Z. Panagiotopoulos, Drios, 2011. (UF library: SCIENCE LIBRARY   QD504 .S25 2006).

Course Schedule (approximate)

Week	Topic	Resources
1	**Introduction and Review**	AZP: 5.1, 5.2, 5.5
2	**Equilibrium and stability**	AZP: 6.1, 6.2
3	**Phase Equilibrium**	AZP: 6.3 – 6.5
4	**EOS, chemical potential, and fugacity**	AZP: 7.3, 7.4
5	**Mixture thermodynamics**	AZP: 8.2-8.4
6	**Ideal mixtures and VLE**	AZP: 8.6, 9.1
7	**Colligative properties**	AZP: 9.5, 9.6
8	**Mixing functions**	AZP: 8.1
9	**Excess properties and activity**	AZP: 8.7, 8.8
10	**Liquid-liquid equilibrium**	AZP: 9.2
11	**VLE for non-ideal mixtures**	AZP: 9.1, 9.3
12	**Chemical equilibria**	AZP: 10.2
13	**Standard states and use of tables**	AZP: 10.3
14	**Example problems**	AZP: 10.4, 10.5

Assessments

Assignment	Percentage of Final Grade
Midterm (M1, M2)	25%
Final (M3, M4)	25%

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Module test M1	15%
Module test M3	15%
Quizzes	5%
Homework	15%
Total	100%

Schedule of Homework, Quizzes, Tests

Homework	Electronic submission – see Canvas pages for due dates and times
Quizzes	Paper submission – unscheduled – closed book
Module tests	Paper submission – in class exam - see Canvas pages for dates – closed book
Midterm and Final	Paper and electronic submission – see Canvas pages for dates – open book

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

University Academic Policies can be found at:
https://syllabus.ufl.edu/syllabus-policy/uf-syllabus-policy-links/

Office hours:

Coming to office hours should be an important component of your study. I encourage you to make time to attend – it will help with exams and homework. To make it more accessible, I am taking advantage of a new college policy which permits virtual office hours. You should be able to login from your Canvas page (Tuesday 4-6). Unless there are objections I plan to record the sessions so that people unable to attend can at least see what went on. I will of course honor specific requests for privacy.

Policies for this class:

a. Homework assignments will be due on Wednesdays at 11:59 pm. Late homework will be penalized at 10% per day – starting at midnight. Students can have up to 3 one-day extensions over the course of the semester, where homework can be submitted without penalty. The extensions are granted automatically – no need to contact the instructor.
Homework more than 2 days late (i.e. after midnight Friday) will not be graded. Homework assignments will be posted at least 1 week ahead of the due date. Students are strongly encouraged to work on assignments during the week, making use of office hours as needed.
b. Homework submissions must be on Canvas as a scanned pdf or (for programs) a .py file. No bitmapped images or screenshots will be accepted for grading.
c. Discussion of homework is encouraged, but the submitted solutions must be your own work. Copying homework solutions from any source is an academic honesty violation for all parties involved.
d. Partial solutions to some homework problems will be posted with the assignment. These are designed to enable students to self check their work. If you have problems getting the correct solution you need to ask questions or come to office hours. Complete solutions will not be provided in general.
e. **Submitted solution must be your own work**. Copying from other students, from the internet, or from AI systems, will be treated as an academic honesty violation.
f. Suspected incidents of academic dishonesty will be referred to SCCR for possible disciplinary action. Check out the orange book for UF policies on student's responsibilities and rights.

g Assigned reading will be included in each weeks homework. Students are expected to be familiar with these materials, as well as material from lectures and written homework.

h Homework and tests may require the use of Python to compute solutions to numerical problems. Students may bring programs to these tests as well as notes and books.

i Requests for re-grading of assignments and exams will only be considered within a one-week period from the time graded work is returned.

j Grades for individual assignments and tests will be posted on the web throughout the semester,. You should ensure that they are entered correctly. Corrections will be considered only within a two-week period after the grades have been posted.

k Students may request a makeup for any activity sponsored by the university, for health reasons, and for family emergencies. Other reasons at the instructor's discretion, but will typically not be allowed. There will be no make up for the final test, except for health or family reasons. In such cases the student will receive an Incomplete grade, with a makeup to be given the following semester. Request for a make up of any assignment must be made at least 1 week in advance of the assignment (emergency health issues aside).

l You are responsible for all announcements made in class and on Canvas