PHASE AND CHEMICAL EQUILIBRIA
ECH4123 | Class Number 23834 | Section 0L07
Class Periods: M, W, F | Period 8 (3:00 PM - 3:50 PM)
Location: Turlington 2333
Academic Term: Spring 2022

Instructor

Dr. Oscar D. Crisalle

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Office Hours: TBA through the Canvas site for the course

Graduate Supervised-Teaching Student

None
Office hours: Not applicable

Undergraduate Supervised Tutor

None
Office hours: Not applicable

Grader

None
Office hours: Not applicable

Course Description

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

Course Pre-Requisites

ECH3101 (Process Thermodynamics), ECH3202 (Fluid and Solid Operations) and ECH3223 (Energy Transfer Operations)

Course Topics

1. Thermodynamics of unary systems
2. Phase equilibrium in unary systems.
3. Thermodynamics of multinary systems

4. Phase equilibrium in multinary systems
5. Vapor-liquid equilibrium in multinary systems
6. Phase equilibrium in multinary fluid systems
7. Introduction to equilibrium in solid mixtures
8. Introduction to chemical equilibrium.

Course Objectives

Upon completion of this course the student will be able to:

1. Understand the theory that describes the thermodynamic properties of phase and chemical equilibria for pure components and mixtures.
2. Evaluate chemical potentials and fugacities for pure components and mixtures.
3. Predict the properties of equilibrium states for pure components and mixtures
4. Solve problems associated with thermodynamics equilibria by hand and with the assistance of software tools.
5. Apply thermodynamics phase and chemical equilibrium theory to liquid-liquid, vapor-liquid, and solid-liquid systems.

Materials and Supply Fees

Not applicable

Professional Component (ABET)

The ABET *Student Outcomes* (SO) assessed in this course are:

1. **SO 1**: An ability to identify, formulate, and solve complex problems by applying principles of engineering, science, and mathematics. (Coverage: HIGH)
2. **SO 7**: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies (Coverage: HIGH)

Required Textbook

Stanley I. Sandler, *Chemical, Biochemical, and Engineering Thermodynamics*, 5th Edition, Wiley, 2006.

Recommended Textbooks

Dahm, Kevin D., and Donald P. Visco, *Fundamentals of Chemical Engineering Thermodynamics,* Nelson Education, 2014.

Chemical and Process Thermodynamics, by B. G. Kyle, Third Edition, ISBN 0-13-081244-7, Prentice Hall (1999)

Introductory Chemical Engineering Thermodynamics, Elliott, J.R., and C.T. Lira", Prentice Hall, Englewood Cliffs, New Jersey (1999).

Introduction to Chemical Engineering Thermodynamics, by J. M. Smith and H. C. Van Ness, Fifth Edition, McGraw-Hill (1996).

Thermodynamics Fundamentals for Applications, by J. P. O'Connell and J. M. Haile, Cambridge University Press. (2005). This textbook covers advanced, graduate-level material. .

Computer Requirement

A laptop computer running MacOS or MS Windows.

Recommended Software

Programming assignments will be carried out using the Python language. The software is free and installation instructions will be provided in class. Python is also available on campus at several *UFIT Computer Labs*, which are referred to as *Learning Centers* (https://labs.at.ufl.edu/). Students who experience difficulty with Python installations in their personal computers should plan on completing their programming assignments (included online exams) at a UF AT Lab.

The instruction will make an announcement at an appropriate time if this course will utilize the MATLAB and Simulink software suite of *TheMathworks*. A *Student Edition* or MATLAB, including Simulink is available at a discounted student price (consult the UF Bookstore).

All software tools are available free of charge to students at the UFIT Computer Labs. In addition, browser-based versions of the software are offered thorough UFApps (https://info.apps.ufl.edu/), though execution times and access may be limited.

Online Lecture Recordings

At the discretion of the instructor, selected class sessions and office-hours sessions may be delivered via teleconference using the Zoom or equivalent platform, and may be audio visually recorded. Students must keep their computer cameras on during the lecture and must show their face in the camera field so the instructor can identify the class members and better communicate according to the perception of facial expressions. By keeping the cameras on, or by showing a Zoom profile image, students are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, you must contact the instructor to discuss options. If your objection stands, be sure to keep your camera off and do not use a profile image.

Likewise, students who un-mute their microphones during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you must contact the instructor to discuss options. If your decision stands, you will need to keep your Zoom mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared.

The recording of zoom sessions without explicit instructor permission is not allowed. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is strongly recommended. Repeated absences will have an adverse effect on the final grade for the course. Excused absences must be consistent with university policies stated in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation. Requests for make-up tests will be granted only if appropriate documentation about illness, family emergency, job interview, or UF-related travel are provided and verified by the Instructor.

Evaluation of Grades

Individual grades in this course will be assigned using the Student T Score Method (for a reference see for example *Teaching Engineering* by Phillip C. Wankat and Frank S. Oreovicz, Purdue University Press, 2015).

The following table shows a reference evaluation of grades policy. The indicated percentage weight entries may be adjusted by the instructor based on his judgement on how to better assess student deliverables. A 0% weight indicates that the deliverable is not included in the original course assessment plant, but that it may be added by the instructor as needed to provide students with venues to better learn the material and demonstrate concept mastery.

Assignment	Total Points[1]	Percentage of Final Grade
Homework	100[2]	10 %
Quizzes	100[2]	20 %
Projects[3]	100[2]	0 %
Final Project	100[2]	15 %
Midterm 1	100	25 %
Midterm 2	100	0 %
Final Exam	100	30 %
Total		100%

[1] The total number of points earned through this component will be normalized to 100.

[2] It is expected that each student will have the total score greater than 50 % on the entire set of assignments in each of the Homework, Quizzes, Projects, and Final Project categories. A failing grade in the course will be assigned if the 50 % threshold is not met in any assignment category.

[3] The Homework and Projects assignment categories may be lumped into a single category at the sole discretion of the instructor.

Grading Policy

The following table illustrates the grading policy adopted in this course.

Score	Range	Letter Grade	Grade Points
0.00	- 46.67	E	0.00

46.68	-	56.67	D-	0.67
56.68	-	60.00	D	1.00
60.01	-	63.33	D+	1.33
63.34	-	66.67	C-	1.67
66.68	-	70.00	C	2.00
70.01	-	73.33	C+	2.33
73.34	-	76.67	B-	2.67
76.68	-	80.00	B	3.00
80.01	-	83.33	B+	3.33
83.34	-	86.67	A-	3.67
86.68	-	100.00	A	4.00

The column of the grading table, labelled Score Range, represents a range of Weighted Percentage Score values. The last two columns indicate the corresponding letter grade and GPA equivalents for each range.

The Score Ranges in the table are calculated following the *Student T Score Method* using an *a priori* assumed mean value of 70 % and a standard deviation of 10 % for the weighted percentage score for the class.

The ranges may change as a function of the final course statistics realized at the end of the course. More precisely, the upper value in the Score Range column may be modified according to the formula

$$\mathbf{Max = Mean + Z * STD}$$

where **Mean** and **STD** are respectively the mean value and the standard deviation for the Weighted Percentage Score for the entire class, and where at his discretion the instructor may assign the following Z-score-based letter grades: $Z = -2$ for an E, $Z = -1$ for a D, $Z = 0$ for a C, $Z = 1$ for a B, and $Z = 2$ for an A.

More information on the UF grading policy may be found at

https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Homework and Projects Scoring Policy

Homework assignments and Projects are a key tools to ensure mastery of the material presented in this course. Therefore, students are expected to submit solutions to all the Homework and Projects assignments, including reasonable attempts to solve each assigned problem. Students are required to review all comments and markings made on their submitted work, and carefully study all posted solutions (including when an assignment score is high) as the solutions may reveal important details that are part of required learning.

The score for an entire assignment will be generated as follow:

0 points: **Very poor** quality (or not attempted)

2 points: **Poor** quality (incorrect but serious attempt)

4 points: **Marginal** quality (significant errors or shortcomings)

5 points: **Satisfactory** quality (mostly correct but with only a few significant errors)

6 point: **Good** quality (with several errors)

8 points: **Very good** quality (with few errors)

10 points: **Excellent** quality (with perhaps a number of very minor errors)

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu/evals. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- College of Engineering Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see:

https://registrar.ufl.edu/ferpa.html

Health

If a student is flagged as "Not Cleared" by the University

Please visit the UF Health Screen, Test & Protect website to get cleared at

https://coronavirus.ufhealth.org/screen-test-protect-2/

or contact the Chemical Engineering Department advisors for assistance on how to get cleared and for any questions about your rights regarding the student clearing process.

Instructions by Associate Dean Curtis Taylor:

"If a student who is withheld from campus attends class, the student should be asked to leave the classroom and be reported to the Dean of Students Office" .

"This would be reported as a student conduct violation".

If you are sick.

1. Stay home and self-quarantine, and please **immediately** visit the UF Health Screen, Test & Protect website

   https://coronavirus.ufhealth.org/screen-test-protect-2/

   about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began.

2. Please also **immediately** contact your primary care provider if you are ill and need immediate care, or contact the UF Student Health Care Center at 352-392-1161 or at covid@shcc.ufl.edu to be evaluated for testing and to receive further instructions about returning to campus. Stay home and self-quarantine, and please **immediately** visit the UF Health Screen, Test & Protect website

3. Please **immediately** contact your primary care provider if you are ill and need immediate care, or contact the UF Student Health Care Center at 352-392-1161 or at covid@shcc.ufl.edu to be evaluated for testing and to receive further instructions about returning to campus. Stay home and self-quarantine, and please **immediately** visit the UF Health Screen, Test & Protect website

4. Please contact the instructor **as soon as your health condition permits it (but not sooner)**, so arrangements can be made to help you catch up or keep up with the lecture pace. Text messaging or phone calls are the fastest and most efficient ways of communication. Take all the time you need to contact the instructor, as dictated by your health condition.

Campus Resources

University Health and Wellness Resources

U Matter, We Care:
If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.ufl.edu/.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.

Syllabus Updates

The instructor reserves the sole discretionary right to modify the contents of the syllabus for this course at any time during the academic term, as needed under his judgement to ensure better attainment of the learning objectives and facilitate mastery of the concepts and principles of the subject matter. Updates will be published in the Canvas Syllabus page for the course.