EMA 6316 – Materials Thermodynamics

Course Syllabus – Fall 2022

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Course Description (3 credit hours)

Thermodynamics of materials systems, surfaces in solids, irreversible processes.

Prerequisites:

EMA 4314: Energetics and Kinetics in Materials Science or any equivalent thermodynamics course.

Course Objectives

This course is one of the four key technical courses foundational to the MSE graduate program: Materials Thermodynamics (EMA 6316), Diffusion, Kinetics and Transport in Materials (EMA 6136), Structure and Mechanical Properties of Materials (EMA 6313), and Properties of Functional Materials (EMA 6114). As a core course, this class covers a significant amount of graduate-level material and is designed to challenge you to advance your knowledge and skills. Success will require a considerable investment in preparing for lectures by using textbooks and other sources that you seek out, solving problems, and studying for exams. It is expected that you will have to exhibit significantly more independence, initiative, and ownership of the learning process than what was required for success at the undergraduate level.

This class reviews the four laws of thermodynamics as the fundamental basis for thermal and chemical equilibrium and introduces a statistical mechanical viewpoint for fundamental thermodynamic variables and the relationships between them. The students will apply these principles to understanding phase equilibria, phase diagrams, heterogeneous reactions, solutions, surfaces, and defects. The use of thermodynamics for practical scientific and technical applications will be emphasized in the course.

Class Time (Attendance of at least two class periods per week is recommended)

Monday, Wednesday	On-Campus students	Period 5	11:45 am - 12:35 pm
Thursday	EDGE students	Double Period	6:00 pm - 7:30 pm

All classes will take place on Zoom at https://ufl.zoom.us/j/95631539520.

Text book: (required)

Title: Thermodynamics in Materials Science, 2nd Edition
Author: Robert DeHoff
ISBN: 0-8493-4065-9

Supplementary reading and links to various other resources/websites are provided and updated throughout the semester.

Course Website

The course website is on the Canvas system https://ufl.instructure.com, where you can find the announcements, syllabus, pre-recorded video lectures, lecture notes, and homework as-

signments. We will also use Canvas for the preparatory quizzes, the course exams, and your grades. Please check it frequently.

Flipped Classroom Model

The course will utilize a flipped classroom model. A flipped classroom is a teaching approach where you will first explore new content outside the class by viewing a **pre-recorded video lecture** and completing a **preparatory quiz** on Canvas.

Our regularly scheduled online class time is organized around student engagement, inquiry, and assessment, allowing us to elaborate on thermodynamic concepts and apply them to materials problems. The in-class sessions will typically entail structured discussions, collaborative problem solving, and case studies. The in-class session will also be recorded and posted on Canvas.

Flipped classroom improved the student performance and learning experience effectively (see for example https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6852382/). To take advantage of the in-class discussion and problem solving requires everyone to watch the video lecture before the in-class activity and complete the quiz. Active participation and engagement in class will help you understand the material and acquire the skills to utilize thermodynamics to solve materials problems you will encounter throughout your career. I will require attendance. Questions are highly encouraged. If you do not understand something, chances are that your classmates have missed that point too. You are responsible for material presented in lectures, reading assignments, homework, and distributed notes.

Homework

Four homework exercises will be assigned. These homework questions are essential to your study and prepare you for the exams. Some exam questions will be adapted from homework. Homework is usually due back seven days before the corresponding exam. The approximate homework due dates are 9/16, 10/6, 10/28, 11/18. The exact submission dates will be posted in the e-learning assignments. The purpose of homework is to give you an opportunity to evaluate and apply their knowledge. You may collaborate on homework; however, the submitted assignment must represent your own work and preparation. Please ask during the online class to discuss homework problems.

Homework in its entirety must be word processed. For some problems, you will require a suitable math package with graphing capability, e.g., Excel, MatLab, Python. Files have to pdf, doc, docx, or pptx. Picture files (jpg, etc.) are not accepted.

Homework needs to be submitted online on e-learning. Email is not acceptable for submission of homework. Hard copies are also not accepted.

Homework will be evaluated on the following basis:

	100	85	70	0
Completion	All assigned work is complete.	Most assigned work is complete.	Some assigned work is complete.	Assignment not complete.
Accuracy	All answers are correct.	Most answers are correct.	Some answers are correct.	Little to no answers are correct.
Work shown (derivations and figures)	All work shown in detail.	Most work shown in detail.	Several steps or figures missing.	Did not show any work.

No credit will be given for late unexcused submissions.

Quizzes and Interactive Learning

We will have online preparatory quizzes covering current and recent lecture material. The quizzes will typically consist of ten questions that should take about 20 minutes to answer. The quizzes serve as feedback both for you and me that you understood the pre-recorded video lectures.

I addition, we will use Kahoot during the online class periods to provide instant feedback about essential concepts.

Exams

We will have four in-class exams. The exams will consist of concept questions to evaluate your familiarity with the course content and numerical problems designed to test your ability to apply concepts to new situations, i.e. to promote critical thinking. Unless otherwise informed, one sheet of prepared personal notes may be used to assist you in completing examinations. The exams will be on Canvas and use HonorLock. Exam work must be individual and collaboration is never allowed. Observations of cheating will be promptly reported by the exam proctor. Please see UF's statement on academic honesty: https://www.dso.ufl.edu/%20sccr/process/student-conduct-honor-code.

There is no final exam in this class. Exam dates are tentatively scheduled for:

Exam 1: September 23, 2022
Exam 2: October 14, 2022
Exam 3: November 4, 2022
Exam 4: December 5, 2022

EDGE Student Submission Policy

EDGE students must submit all homework assignments electronically by the given deadlines. Exams must be received no more than four days after the in-class exam date. Please scan documents as a pdf and submit them electronically or via fax. The exams will be on Canvas and use HonorLock. If any problems occur, please let me know early. No credit will be given for late unexcused submissions.

Exam Conflicts with other course exams

The official UF policy on exam conflict resolution states that when two exams conflict, the course with the higher number will take priority.

Make-up exams

Make up exams will be provided only with the ***prior approval of the instructor.*** Excused absences must be consistent with university policies in the Graduate Catalog (https://catalog.ufl.edu/graduate/regulations) and require appropriate documentation. Additional information can be found here: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/. In general, acceptable reasons for excused absence from an exam include illness, serious family emergencies, special curricular requirements, military obligation, court-imposed legal obligations, and religious holidays. In all cases, you will be required to provide written documentation, and obtain prior instructor approval. You will not be excused from any exam without following the policy above, with no exceptions. Students not in attendance for the scheduled exam will receive a score of zero. **You must notify the instructor no less than 1 week of the scheduled exam of your intent and justification for missing the exam.** Make-up exams for excused absences as well as exam conflicts must occur within 1 week of the missed exam, and may occur before the missed exam.

Grading

Grades will be based on your understanding and mastery of the material as demonstrated by the exams, preparatory quizzes, and homeworks.

Homework	10%
Preparatory Online quizzes	10%
4 exams	80%

To account for varying performance in the exams, your best exam score will count 25% and your worst exam only 15%. The other two exams will count 20%. You have two weeks after the test results are posted to resolve any questions about scores and grades. No changes to your exam grade will be made after that time.

Grading Scale

This course follows current UF grading policies for assigning grade points

Percentage	≥92	≥88	≥84	≥80	≥76	≥72	≥68	≥65	≥62	≥59	≥56	<56
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
Grade Points	4.0	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	0.67	0

In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

Online Course Recording

Our class sessions will be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their cam-

era engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute 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 will need to keep your 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. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Record keeping

All materials from this class that students did not pick up (graded exams, etc.) within 1 year of the end of class will be shredded on or after December 31, 2022.

Syllabus Changes

I reserve the right to make changes in the syllabus as needed. Any changes will be clearly announced on canvas and in class.

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 Conduct Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. 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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Assoc. Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Assoc. Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity. Accommodation for Students with Disabilities

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Campus Resources

Health and Wellness

U Matter, We Care: Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

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

Sexual Discrimination, Harassment, Assault, or Violence: If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

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/.

COVID-19: You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated. If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.

If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.

UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the UF Health Screen, Test & Protect website for more information.

Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

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://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.
On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.

Week	Class dates	Topics	Book chapter
1	August 24 August 25	History and Introduction of Thermodynamics	1
2	August 29 August 31 September 1	Structure of Thermodynamics	2
3	September 5 September 7 September 8	The Four Laws	3
4	September 12 (online) September 14 September 15	Variables and Relations	4
Homework 1 due on September 16			
5	September 19 September 21 September 22	Equilibrium	5
Exam 1 on September 23			
6	September 26 September 28 September 29	Statistical Mechanics	6
7	October 3 October 5 October 6	Statistical Mechanics Unary Phase Diagrams	7
Homework 2 due on October 6			
8	October 10 October 12 October 13	Partial Molar Quantities	8
Exam 2 on October 14			
9	October 17 October 19 October 20	Partial Molar Quantities	8
10	October 24 October 26 October 27	Construction of Phase Diagrams	9
Homework 3 due on October 28			
11	October 31 November 2 November 3	Thermodynamics of Phase Diagrams	9
Exam 3 on November 4			
12	November 7 November 9 November 10	Thermodynamics of Phase Diagrams	10
13	November 14 November 16 November 17	Reactions	11
Homework 4 due on November 18			
14	November 22	No class	
15	November 29 December 1 December 2	Oxidation	11
Exam 4 on December 5			