

Process Thermodynamics

ECH 3101 Section 1234

Class Periods: T,R, Periods 6-7 (12:50 PM - 2:45 PM)

Location: WM 100 (Williamson Hall)

Academic Term: Fall 2024

Instructor:

Helena Hagelin Weaver

Email Address: hweaver@che.ufl.edu

Office Phone Number: (352) 392-6585

Office Hours: TBD, or by appointment, CHE 323.

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Sree Laxmi, sree.laxmi@ufl.edu, Office Hours: TBD

Course Description

4 credit hours. Introduces fundamental principles of classical and statistical thermodynamics. Applications to modeling and analysis of physical and chemical processes undergoing change.

Course Pre-Requisites

COP 2273 (Python Programming for Engineers)

Course Co-Requisites

COT 3502 (Computer Model Formulation)

Course Objectives

Upon completion of this course, a student should be able to:

1. Formulate the first, second, and third laws of thermodynamics.
2. Develop and solve mathematical models for closed and open non-reactive systems using mass, energy, and entropy balances.
3. Apply thermodynamics to analysis of industrial processes, such as power generation and gas liquefaction.
4. Estimate thermodynamic properties of pure gases and liquids using equations of state and thermodynamic graphs and tables.
5. Apply statistical mechanics to compute thermodynamic properties of an ideal gas and explain the role of molecular interactions in deviations of real substances from the ideal gas behavior.

Materials and Supply Fees

N/A

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Medium
3. An ability to communicate effectively with a range of audiences	
4. 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	Low
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Low
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

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

Required Textbooks and Additional Notes

- Title: Chemical, Biochemical, and Engineering Thermodynamics
- Author: S. I. Sandler
- Publication date and edition: 5th edition (2017)
- ISBN: 978-0-470-50479-6
- Additional notes on statistical thermodynamics will be provided by the instructor.

Note: Exams are open-book. Therefore, a printed copy of the book is required, and use of computers and cell phones will be prohibited on the exams.

Recommended Materials

- Title: Essential Thermodynamics: An undergraduate textbook for chemical engineers
- Author: A. Z. Panagiotopoulos
- Publisher and date: Createspace Independent Publishing Platform (2011)
- ISBN: 978-1451564945

- Title: Entropy Demystified. The Second Law Reduced to Plain Common Sense
- Author: A. Ben-Naim
- Publisher and date: World Scientific Publishing Company (2008).
- ISBN: 978-981-4338-39-4 (<https://doi.org/10.1142/6916>).

Required Computer

UF student computing requirement: <https://news.it.ufl.edu/education/student-computing-requirements-for-uf/>

Specific computer requirements:

Operating System: Windows 10 or 11.

Processor: Intel Core-i5 – i7 family.

Memory: 16GB RAM

Storage: SSD with 120-250GB of available space.

Monitor: Graphics hardware acceleration requires a DirectX10 graphics card and a 1280 x 1024 or higher resolution monitor.

Network: 100MB/Sec.

Course Website (Canvas)

- To access the class E-learning (Canvas) website, go to [elearning.ufl.edu](https://learning.ufl.edu).
- Any lecture slides used in class will be posted on the course website (in a Lecture Slides folder).
- Homework assignments will be announced using Canvas and made available on the course website (in a Homework Assignments folder).
- Additional material relevant for the class will also be made available on Canvas (in a separate Additional Material folder).

Course Schedule

Week	Topics	Corresponding Book Chapters	Exams
Week 1	Introduction and Definitions	Chapter 1	
Week 2	Mass and Energy Balances, Thermodynamic Properties, First Law of Thermodynamics	Chapters 2, 3.1-3.3 + Instructor Notes	
Week 3	Applications of Mass and Energy Balances, Introduction to Entropy	Chapters 3.2-3.4, 4.1	
Week 4	State Variables and Entropy, Thermodynamic and Statistical Mechanics Definition of Entropy	Chapters 3.4, 4.1 + Instructor Notes	
Week 5	Heat, Work and Entropy, Applications of the Second Law of Thermodynamics	Chapters 4.2, 4.3	
Week 6	Review	Chapters 1-4	Exam #1
Week 7	Entropy and Thermodynamic Diagrams	Chapters 4.2-4.4	
Week 8	Engine Efficiency, Liquefaction	Chapters 4.3, 5.1	
Week 9	Power Cycles, Thermodynamic Efficiencies	Chapters 5.2-5.3 + Instructor notes	
Week 10	Refrigeration Cycles, Isentropic Efficiency, Thermodynamics of Explosions	Chapters 5.2-5.4	
Week 11	Review	Chapters 4-5	Exam #2
Week 12	Thermodynamic Properties of Real Fluids, Departure Functions	Chapters 6.1-6.4	
Week 13	Intermolecular Interactions and Equations of State	Instructor Notes	
Week 14	Principles of Corresponding States, Generalized Equations of State	Chapters 6.6-6.7	
Week 15	Third Law of Thermodynamics, Critical Properties, Sonic Velocity	Chapters 6.8-6.10	
Week 16			Exam #3

Important Dates (Suggested):

September 24 or 26 Exam 1 (12:50-02:45 PM, Location:TBA)
October 29 or 31 Exam 2 (12:50-02:45 PM, Location:TBA)
December 11 Exam 3 (8:00-10:00 PM)

Homework will be given on Thursdays and will be due the following Thursday. While most homework assignments are not collected, it is expected that students work through the homework problems as a quiz will be given on the Thursday the homework is due on the topic of the homework. Solutions to homework problems will be available on Canvas

Attendance Policy, Class Expectations, and Make-Up Policy

- Attendance of lectures is highly encouraged, but not required. It is the student's responsibility to obtain any notes, assignments, etc., that they may have missed during their absence.
- As a courtesy to the other students and to the instructor, the students should turn off the ringers for all cell phones during class and they should not answer incoming calls. If a student is expecting an emergency call, please notify the instructor prior to class.
- Make-up exams will be given for excused absences and in extraordinary circumstances, such as religious holidays or emergencies. It is required that, whenever possible, the student notifies the instructor about the situation prior to the exam, preferably at least two weeks in advance. Excused absences are consistent with university policies in the undergraduate catalog and require appropriate documentation:
<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.
- Note: there will be no individual make-up quizzes. One make-up quiz will be given at the end of the semester. Provided all quizzes are attempted, one quiz with the lowest score will be dropped before grades are assigned.
- Students arriving late for a quiz/exam will be given only the balance of time remaining to complete their work unless an acceptable reason is provided (in accordance with excused absences).
- Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:
<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Assignments/Quizzes	100 each	25%
Exam #1	100	25%
Exam #2	100	25%
Exam #3	100	25%
		100%

Grading Policy

Grades for this class are curved at the discretion of the instructor. Please note that a C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement.

The following is an approximate grading scale.

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

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

Students Requiring Accommodations

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.

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/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

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://sccr.dso.ufl.edu/process/student-conduct-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 varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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 Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu
- Toshikazu Nishida, Associate 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.

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>

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/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://elearning.ufl.edu/>.

Career Connections 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: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.