

PROCESS THERMODYNAMICS

ECH3101 | Class Number 23737 | Section PT01

Class Periods and Locations

M, W, F | Period 6 (12:50 PM – 1:40 PM) | PUGH 170

Academic Term: Fall 2022

Instructor

Dr. Oscar D. Crisalle

*Professor and Distinguished Teaching Scholar
University of Florida, Chemical Engineering Department*

Room: 419a ChE Bldg.
Email: crisalle@ufl.edu
Office Phone: 352-392-5120

Office Hours: TBA through the Canvas site for the course

Graduate Supervised-Teaching Student

To be Announced

Office hours: To be announced through the Canvas site for the course

Please contact through the Canvas Website

Undergraduate Supervised Tutor

None

Office hours: Not applicable

Course Description

Introduction to fundamental principles of thermodynamics including the first and second laws of thermodynamics. The main focus is on the development of skills allowing solving problems that involve closed and open systems as well as selected processes.

Course Pre-Requisites

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

Course Objectives

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

1. Demonstrate knowledge of the definition and origin of the extensive and intensive thermodynamic variables as well as the laws of thermodynamics used to solve problems involving closed and open systems as well as selected thermodynamic processes

- Determine the thermodynamic properties of pure substances and simple mixtures using the ideal-gas approximation, equations of states, and thermodynamic graphs and tables.
- Develop mathematical descriptions of closed and open systems, with pure substances, using mass, energy, and entropy balances.

Course Topics

- Thermodynamics definitions, fundamental concepts, and physical units of thermodynamics states.
- The mass balance equation. Derivation and applications.
- The energy balance equation. Derivation, application to ideal gases, water, and real substances. Maxwell's Lever Rule.
- The entropy balance equation. Derivation and application to ideal gases and real gas, liquid and solid substances. Applications to compressors, turbines, and the Carnot Engine.
- Power cycles.
- The properties of real substances. Equations of state, exact and inexact differentials, differentials of intensive and extensive variables, calculation of state changes using departure functions.

Materials and Supply Fees

Not applicable

Relation to Program Outcomes (ABET)

Student Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

Required Textbook and Software

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

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 instructor will make an announcement at an appropriate time if this course will utilize the MATLAB and Simulink software suite of *TheMathworks*. A *Student Edition* of 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 through UFApps (<https://info.apps.ufl.edu/>), though execution times and access may be limited.

Recommended Materials

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.

Fundamentals of Chemical Engineering Thermodynamics, by Dahm and Visco ISBN: 978-1111580704.

Computer Requirement

A laptop computer running MacOS or MS Windows.

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 audiovisually 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	Points	Percentage of Final Grade
Homework ⁴	100 ²	20 %
Quizzes	100 ²	20 %
Final Project	100 ^{2,3}	10 %
Midterm 1	100	25 %
Final Exam	100	25 %
<i>Normalized Total</i>	100 ¹	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 this category. A failing grade in the course will be assigned if the 50 % threshold is not met in this assignment category.
- ³ A failing grade in the course will be assigned for failure to submit a Final Project deemed of unacceptable quality by the instructor.
- ⁴ The Homework category may include Project Assignments, at the 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

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

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

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: **Unacceptable** quality (or not attempted)
- 2 points: **Poor** quality (incorrect but serious attempt)
- 4 points: **Marginal** quality (significant errors or shortcomings)

- 6 points: **Adequate** 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 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 `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://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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennarcc@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

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://lss.at.ufl.edu/help.shtml>.

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/state-authorization-status/#student-complaint>.