Thermodynamics 1

EML 3100, Spring 2024

MWF 2nd Period – 8:30 AM to 9:20 AM

Zoom Link : https://ufl.zoom.us/j/95834856700

Students are to attend all classes, with **camera ON**. Attendance will be taken, and participation will be noted.

Instructor:

Dr. Andrés Rubiano

For all grade-related communications, please contact Nicholas Sardinia (TA) directly through a Canvas message. Please type "*Thermodynamics Student:*" before your subject in the subject line. No need to discuss quiz grades with him nor me.

For all other class communications with me, please attend office hours.

Office Hours: Monday and Wednesday 5:30 PM – 6:30 PM

Zoom Link:
Please sign up for an appointment, at least 3 hours in advance, using this link: https://calendly.com/dr-rubiano/office-hoursLinks to an external site.

You can sign up for more than one 5-minute slot if you foresee a longer meeting.

Additional Office hours: as many as you want. Send me a Canvas message with a "Thermodynamics - Office Hours" subject line and a *when2meet* link with your own availability, and I'll reply to you with a time that works for both.

Teaching Assistant:

Nicholas Sardinia - nicholassardinia@ufl.edu - Zoom Link:

Office Hours:

Course Description

Application of the first and second laws of thermodynamics to closed and open systems and to cyclic heat engines. Includes the development of procedures for calculating the properties of multiphase and single phase pure substances. Credits: 3

The Southern Association of Colleges and Schools Commission on Colleges provides the federal definition of the credit hour as the equivalent to one hour of in-person instruction and at least two to three hours of out-of-class work per week in a 15-week semester. Source: citt.ufl.edu

Prerequisites

Reading Comprehension, Physics, Calculus, and Chemistry.

IMPORTANT:

Microsoft Excel will be widely used to solve problems. You can use Python or MATLAB, alternatively.

Civil Engineering significant figures rules will be used for answer values.

Class Structure:

At least a day before *every* class meeting, you are to:

- **study** the one 8-12-minute lecture main video (1-hour worth of lecture content). Set aside at least an hour to watch it, understand it, and take notes.
- study the 1-4-minute additional example videos for each lecture topic.
    - attempt to solve these problems **before** watching the solution.
- solve the assigned textbook-style problems corresponding to the previous class topic.

Students are to attend all classes. Attendance will be taken, and participation will be noted.

Class meeting times will be used to:

- Present a brief summary of the topics covered in the lecture video.
- Answer specific questions about the textbook-style problems from the previous class.
- Answer specific questions about the lecture and example videos due that day.
- Analyze and discuss textbook-style problems (without actually solving them).
- Take in-class pop quizzes. Discuss quiz and exam solutions.

Course Assignments:

Homework:

- At least a day before every lecture day (not the day of), you must **study** the linked lecture and example videos for that day.
    - For the example of the main lecture video, create your own solution using Excel/MATLAB/Python and include your written work. Your solution's numbers might not fully match with those in the video. This is intentional.

- For the example videos, try solving them using Excel/MATLAB/Python and include your written work, before watching the solution portion of the video. Be as organized as possible. If there are any questions about the solution, write it down to ask about it in class. Your solutions' numbers might not fully match with those in the videos. This is intentional.
- Complete all textbook-style problems assigned during the previous class using Excel/MATLAB/Python, and include your written work. Your solution's numbers should match exactly those offered as answer values.

Organize and label your work neatly. There is no required labelling scheme, but use consistent names that help you find your work. Example if using Excel: for any given lecture, have an Excel spreadsheet labeled with the lecture number and topic (e.g. *Lecture 07 - Quality and Interpolation)*, that has multiple tabs, one for each problem. Each problem should have clear calculations and equations. Go as far as color-coding your cells.

Only answer values will be offered for the assigned problems discussed in class. If you have questions about the solution, you can ask them during class meeting times. The solution to those problems will not be uploaded at any point during the semester.

Any of your problem solutions can be a) randomly requested during a quiz, or b) asked to be opened and modified during quizzes, and are therefore mandatory and essential to perform well in the class.

Quizzes:

Pop quizzes will be given during lecture meetings. Why not scheduled quizzes? Studying and memorizing information right before a scheduled quiz does not result in overall retention of engineering knowledge or successful development of critical thinking skills.

Quiz time will appear limited and quiz problems challenging, if homework assignments are not completed.

Quizzes are a collection of numerical inputs (fill in numerical values of variables) and are graded automatically on Canvas. We will cover the use of Excel and proper significant figures during class time.

Exams:

There will be 4 cumulative, 50-minute exams. These will be given during lecture time.

We will not meet for class on the day of an exam. The exams will be taken online, and they will begin and end with the class time period. You will record yourself and your on-screen work, while working on the exam, and submit your recording to the *Recording* assignment. You will need a working webcam and OBS set up (installation and set up instructions found in the Files tab).

Only one exam question will show at a time, and each question will lock after you submit your answers.

Written work submissions: you will be given the opportunity to upload your written work and software calculations (Excel, MATLAB, Python) for exams.

Exams Schedule: February 7th, February 23rd, March 27th, and April 22nd.

Grading: Homework (0%, but they are necessary to perform well during quizzes), Quizzes (0%, but they are necessary to develop critical thinking skills for exams), Exam 1 (30%), Exam 2 (20%), Exam 3 (25%), Exam 4 (25%).

Grade Changes: Corrections of grades should be submitted to the TA as a Canvas message within 5 business days of the grade posting in writing with a concise statement of why you believe there has been an error. Otherwise, the grade will remain unchanged. Use a proper subject line and include supporting documentation.

Make-up Policy: Missed exams will result in a zero grade, except in cases of personal or family emergencies, and will be handled on a case by case basis. In cases of emergency, the missed grade will be replaced by the grade of the following exam due to the cumulative nature of the course. If you know you'll be missing a class, let Dr. Rubiano know in advance. Send Dr. Rubiano a Canvas message after you receive the grade that will replace the zero you initially obtained.

Calculations: The video examples don't always use the most accurate unit conversions (273 K instead of 273.15 K). For your homework, quizzes, and exams, always use the most accurate version of unit conversions.

Course Content and Schedule:

Date		Day	Lecture(s)	Content	Lecture Links
January	8	M		Syllabus	
January	10	W	1 & 2	Units and Base Concepts Zeroth Law	https://youtu.be/3OyKUPur-eI https://youtu.be/wquovmwWhi https://youtu.be/FCZjgM8iHlE https://youtu.be/Ygm9Gr21Ib8 https://youtu.be/_me_AhPQ_dA
January	12	F	3 & 4	Open vs. Closed Systems First Law	https://youtu.be/b_FcNpZmpuM https://youtu.be/PKk3N32XKmU https://youtu.be/7TzDUt4j27w https://youtu.be/LjCTylK-RPQ https://youtu.be/WlS_ESOxnCE
January	15	M	Holiday	-	-
January	17	W	5 & 6	Efficiency	https://youtu.be/eHhQ3VkQHe https://youtu.be/D9UEMGsJXxU https://youtu.be/iZbnY0QWHe https://youtu.be/VJkyhHQjcuY

				Tv Diagrams and Tables	https://youtu.be/fRJUwyxGXQv https://youtu.be/OQD9IAqo9xM
January	19	F	7	Quality and Interpolation	https://youtu.be/uISkuT6Mcxw https://youtu.be/q7a8doOFt-k https://youtu.be/jdLkEndf0GI https://youtu.be/uX_Nk2hSxuU
January	22	M	8	Enthalpy and Internal Energy	https://youtu.be/6Y_xjxUBd6Y https://youtu.be/OVmR-fVIIok https://youtu.be/38yfgPfIXPg https://youtu.be/MRzVZ6e9v5I
January	24	W	9	Compressed Liquids	https://youtu.be/okVLi--oAp0
January	26	F	10	Ideal Gas and Compressibility	https://youtu.be/_L1Zhv3Os2o https://youtu.be/rAlwqLo2Y1k https://youtu.be/bCwlFqQgdKc https://youtu.be/ErJyvW9LAF4
January	29	M	11	Specific Heats	https://youtu.be/uGYAXsRmpR https://youtu.be/OUbEHKNYFw https://youtu.be/1QYJsDzAJDs https://youtu.be/IwRl3G5sl_Q
January	31	W	12	Incompressible Fluids	https://youtu.be/uOn9yWIajfQ https://youtu.be/iA2nZ3_4dsE
February	2	F	-	Independent Work	Catch Up
February	5	M	13	Polytropic Processes	https://youtu.be/xkFsBKf_Mbg https://youtu.be/NQdqiEHNs1C https://youtu.be/gYpDxuEYbns
February	7	W		Exam 1	
February	9	F	14 & 15	Volumetric and Mass Flow Rates & Flow Work & Open Systems	https://youtu.be/eXQfKThM7KM https://youtu.be/4oWgVuoa3dc https://youtu.be/ysXzR6SpBV8 https://youtu.be/1pp4y9cwyK4 https://youtu.be/HleudqDDd9v https://youtu.be/37okuizUDJI https://youtu.be/-NeZn3xQUKA https://youtu.be/THWqP9EehC
February	12	M	16	Pipe Flow, Nozzles, Diffusers, and Throttling Devices	https://youtu.be/k0FaAI65vNE https://youtu.be/Y1VQBR-Q_AI https://youtu.be/Akdn7ZXzZ_A https://youtu.be/36uBMFevqRw
February	14	W	17	Turbines, Compressors, Pumps,	https://youtu.be/AHVvKzXYIcY https://youtu.be/6O2jcF74ZaE https://youtu.be/vxRCxWZP2Q https://youtu.be/O_-eHl1wJ_M
February	16	F	18	Heat Exchangers and Mixing Chambers	https://youtu.be/9szCFpV_yII https://youtu.be/30yb-a21LVs

					https://youtu.be/CrKhMzyQ6PU https://youtu.be/9AIh1twwaVw
February	19	M	-	Independent Work	
February	21	W	-	Review	
February	23	F	-	Exam 2	
February	26	M	19	Transient Systems (Unsteady Flow)	https://youtu.be/zW3I7IDyosE https://youtu.be/3JU_PyXSMOI https://youtu.be/0Osf_peMbg0 https://youtu.be/0JAbIbEra0o
February	28	W	20	2nd Law Intro and Power Cycles	https://youtu.be/SOpSbCxmaA https://youtu.be/-EQ5cVq-tWU https://youtu.be/YRPFM1S4YJ8 https://youtu.be/wzF3N9c7wRA
March	1	F	21	Refrigeration and Heat Pumps	https://youtu.be/uF4UGM6xMp https://youtu.be/nhmDGil-_Vc https://youtu.be/zav4R7DIwJE https://youtu.be/U2zgbQ5k0Oc
March	4	M	22	Reversibility and Carnot Cycles	https://youtu.be/8EcvFxJmFI4 https://youtu.be/0NuMdKuiA84 https://youtu.be/M_qz9i2Rr6s
March	6	W	23	Entropy as a Property	https://youtu.be/49Nbpcv4sVg https://youtu.be/99y2Q-EvMbE https://youtu.be/hoRXBkE3XcY
March	8	F	-	Entropy and Integrated Problems	
March	11	M	-	Spring Break	-
March	13	W	-	Spring Break	-
March	15	F	-	Spring Break	-
March	18	M	-	Optional Exam (Basic Thermodynamics Concepts Check)	No Class (No Zoom Meeting)
March	20	W	24	Reference Entropy and Specific Heats	https://youtu.be/kinE5eTVgQw https://youtu.be/0gUUejcsJ1Q https://youtu.be/cPLWt5TRJ2s https://youtu.be/nI73JIGWQEC
March	22	F	25	Isentropic Efficiency	https://youtu.be/K2A5gdROVZI https://youtu.be/pPkGtXqov6E https://youtu.be/qyuRukneC5I https://youtu.be/EqOS9aFl3Ao
March	25	M		Review	
March	27	W		Exam 3	
March	29	F	26	Brayton Cycle	https://youtu.be/fZ80tkxWa-4

					https://youtu.be/3MqkSjXZse8 https://youtu.be/nMJoLmV1dlc https://youtu.be/Odefd6YPRnI
April	1	M	27	Intercooling, Reheating, and Regenerators	https://youtu.be/EBQJv8pry2k https://youtu.be/p6A-w9Pt5IM https://youtu.be/wPjLapXwk_w
April	3	W	28	Otto Cycle	https://youtu.be/q5vgBPb8gSc https://youtu.be/dv91U1O_tv8 https://youtu.be/9gGsjg63AWC https://youtu.be/Xv3Oiijjy_w
April	5	F	-	Engineering Problems Assigned	
April	8	M	-	Independent Work	
April	10	W	-	Independent Work	
April	12	F	-	Independent Work	
April	15	M	29	Standard Diesel Cycle	No YouTube Lectures. Content will be covered in class. T goal is to assess how quickly you c process new info without prior preparation.
April	17	W	30	Rankine Cycle	No YouTube Lectures. Content will be covered in class. T goal is to assess how quickly you c process new info without prior preparation.
April	19	F	-	Review	
April	22	M		Exam 4	
April	24	W		Grades Finalization Begins	

Other Course Information

Textbook:

Thermodynamics, An Engineering Approach"; Yunus Cengel and Michael Boles; McGraw Hill;

Ninth Edition, ISBN: 978-1260048667. You can opt-in through UF all-access to obtain at a lower price.

Other Useful Course Related Resources:

Thermochemical Tables - https://janaf.nist.gov/Links to an external site.
Thermophysical Properties - https://webbook.nist.gov/chemistry/fluid/Links to an external site.
NIST Chemistry WebBook - https://webbook.nist.gov/chemistry/Links to an external site.
Python and Jupyter - https://www.anaconda.com/Links to an external site.
Cantera - https://cantera.org/Links to an external site.

Grading Scale: The final grade will be calculated by the following table.

Table 1. Grading Table. *%GE = Percent Grade Earned.*

Percentage Range	Grade Point
93.33 %GE 100.00 A	4.00
90.00 %GE 93.33 A-	3.67
86.67 %GE 90.00 B+	3.33
83.33 %GE 86.67 B	3.00
80.00 %GE 83.33 B-	2.67
76.67 %GE 80.00 C+	2.33
73.33 %GE 76.67 C	2.00
70.00 %GE 73.33 C-	1.67
66.67 %GE 70.00 D+	1.33
63.33 %GE 66.67 D	1.00
60.00 %GE 63.33 D-	0.67
00.00 %GE 60.00 E	0.00

Course Objectives:

The objective of this course is for students to learn about energy conversion to

describe physical systems relevant to today's world. Such systems include, but are not limited to, fossil fuel powered fired power plants, renewable power plants, combustion engines, Stirling engines, refrigeration, heat pumps and chemical reactors. Systems will be described applying the laws of energy and mass conservation and their application to of the Second Law of Thermodynamics. This class will provide a framework to understand the fundamentals of energy conversion from a somewhat broad and macroscopic perspective, going into fine mechanistic details of specific systems only sporadically. With the skillset obtained in this class, students will have the necessary tools to understanding and analyze a broad range energy conversion processes, a necessary prerequisite for the ultimate design and engineering of more cost effective and efficient systems in the future.

Relevance:

All (or almost all) energy ultimately is derived from the sun. The suns photons are converted in nature to heat, wind, biomass and rain, all of which can be further transformed into heat, work or electricity via a number of processes and thermodynamic cycles. As such, energy and energy conversion surround and sustain our daily lives, from the sunlight used to grow food, to its transportation via rail, ship or truck, to its storage in our refrigerators, to electricity provided from fossil or renewable sources.

Our metabolic cycles convert the energy stored in our food to do work, analogously to the way a combustion engine converts the energy stored in gasoline to drive a car. Understanding the concept of energy and mass conservation will allow one to approach, analyze and appreciate these systems from a simplified energetic point of view to the more complex underlying mechanisms driving them.

General Course Schedule:

Week 1 – Introductory Concepts

Week 2 – Energy Transfer and the First Law of Thermodynamics

Week 3 – Properties of Pure Substances

Weeks 4 and 5– Closed System Analysis

Weeks 6 and 7 – Open System Analysis

Week 8 – Second Law of Thermodynamics

Week 9 – Spring Break

Week 10 – Entropy

Week 11 – Gas Power Cycles

Week 12 – Vapor and Combined Power Cycles

Week 12 – Refrigeration Cycles

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	Low
3) an ability to communicate effectively with a range of audiences	Low
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	High
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	Low
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	Medium

Academic honesty

All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your

obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.

Accommodation for Students with Disabilities

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/evalsLinks to an external site.. 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/Links to an external site..

Health and Wellness

- 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/cwcLinks to an external site., 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/Links to an external site..

Software Use

All faculty, staff and student 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 regarding grades earned in courses and on individual assignments. For more information, please see: http://registrar.ufl.edu/catalog0910/policies/regulationferpa.htmlLinks to an external site.

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
- Robin Bielling, Director of 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