Thermodynamics 1

EML 3100, Summer 2023

MWF 5th Period – 2:00 PM to 3:15 PM

https://ufl.zoom.us/j/95605393262

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

Instructor:

Dr. Andrés Rubiano

All class communication through Canvas messages.

Office Hours: Monday and Wednesday: 5:00 PM – 6:00 PM

Additional Office hours: as many as you want. Send me a Canvas message with an "Office Hours" subject and a when2meet link availability, and I'll reply to you with available times.

Teaching Assistant:

Chenyu Liang – liangc@ufl.edu – Zoom Link: TBD

Office Hours: TBD

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

Class Structure:

Before *every* class meeting, you are to:

- **study** the one 8-12-minute lecture main video (1-hour worth of lecture content).
- watch the two or three 1-4-minute "additional examples videos" for each lecture topic.
    - attempt to solve these problems **before** watching the solution.
- solve the textbook-style-exercises homework assignment.

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

Class meeting times will be used to:

- answer specific questions about lecture videos, example videos, and homework (in that order).
- work on one engineering-specific problems.
- take in-class pop quizzes.

Course Assignments:

Homework:

There is one homework assignment for every day of class (textbook-style problems, very similar to the video example solutions). Homework assignments will not be graded, but they are essential to properly prepare for class, quizzes, and exams. Therefore, homework is mandatory, despite not having a grade assigned to it. Assignments are found under the "Homework" folder in the course files.

Quizzes:

Approximately 12 quizzes total; mostly 30-minute quizzes. 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.

Written work submissions: you will be given the opportunity to upload your written work and EXCEL calculations for each quiz and exam. However, keep in mind that your entire work will be re-graded, and that your new grade can be lower than what you originally received.

Exams:

There will be 3 cumulative, 75-minute exams. These will be given during lecture time.

Exams Schedule: June 12th, July 7th, August 9th.

Grading: Quizzes (40%), Exam 1 (20%), Exam 2 (15%), Exam 3 (25%).

Grade Changes: Corrections of grades should be submitted to the TA 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.

Make-ups: Make-up exams will not be granted except in cases of emergency and will be handled on a case by case basis.

Course Content and Schedule:

Date	Day	Lecture(s)	Content	Lecture Links
May 15	M	1	Units and Base Concepts	https://youtu.be/3OyKUPur-eI https://youtu.be/wquovmwWhi4 https://youtu.be/FCZjgM8iHlE https://youtu.be/Ygm9Gr21Ib8
May 17	W	2 & 3	Zeroth Law Open vs. Closed Systems	https://youtu.be/_me_AhPQ_dA https://youtu.be/b_FcNpZmpuM

May	19	F	4	First Law	https://youtu.be/PKk3N32XKmU https://youtu.be/7TzDUt4j27w https://youtu.be/LjCTylK-RPQ https://youtu.be/WlS_ESOxnCE
May	22	M	5 & 6	Efficiency Tv Diagrams and Tables	https://youtu.be/eHhQ3VkQHeU https://youtu.be/D9UEMGsJXxU https://youtu.be/iZbnY0QWHe8 https://youtu.be/VJkyhHQjcuY https://youtu.be/fRJUwyxGXQw https://youtu.be/OQD9IAqo9xM
May	24	W	7	Quality and Interpolation	https://youtu.be/uISkuT6Mcxw https://youtu.be/q7a8doOFt-k https://youtu.be/jdLkEndf0GI https://youtu.be/uX_Nk2hSxuU
May	26	F	8	Enthalpy and Internal Energy	https://youtu.be/6Y_xjxUBd6Y https://youtu.be/OVmR-fVIIok https://youtu.be/38yfgPfIXPg https://youtu.be/MRzVZ6e9v5k
May	29	M		Memorial Day Holiday	
May	31	W	9 & 10	Compressed Liquids Ideal Gas and Compressibility	https://youtu.be/okVLi--oAp0 https://youtu.be/_L1Zhv3Os2o https://youtu.be/rAlwqLo2Y1k https://youtu.be/bCwlFqQgdKc https://youtu.be/ErJyvW9LAF4
June	2	F	11	Specific Heats	https://youtu.be/uGYAXsRmpRI https://youtu.be/OUbEHKNYFwg https://youtu.be/1QYJsDzAJDs https://youtu.be/IwRl3G5sl_Q
June	5	M	12	Incompressible Fluids	https://youtu.be/uOn9yWIajfQ https://youtu.be/iA2nZ3_4dsE
June	7	W	13	Polytropic Processes	https://youtu.be/xkFsBKf_Mbg https://youtu.be/NQdqiEHNs1Q https://youtu.be/gYpDxuEYbns
June	9	F		Review	
June	12	M		Exam 1	
June	14	W	14	Volumetric and Mass Flow Rates	https://youtu.be/eXQfKThM7KM https://youtu.be/4oWgVuoa3do https://youtu.be/ysXzR6SpBV8 https://youtu.be/1pp4y9cwyK4

June	16	F	15	Flow Work & Open Systems	https://youtu.be/HleudqDDd9w https://youtu.be/37okuizUDJI https://youtu.be/-NeZn3xQUKA https://youtu.be/THWqP9EehCQ
June	19	M	16	Pipe Flow, Nozzles, Diffusers, and Throttling Devices	https://youtu.be/k0FaAI65vNE https://youtu.be/Y1VQBR-Q_AE https://youtu.be/Akdn7ZXzZ_A https://youtu.be/36uBMFevqRw
June	21	W	17	Turbines, Compressors, Pumps,	https://youtu.be/AHVvKzXYIcY https://youtu.be/6O2jcF74ZaE https://youtu.be/vxRCxWZP2Qk https://youtu.be/O_-eHl1wJ_M
June	23	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
June	26	M		Summer Break	
June	28	W		Summer Break	
June	30	F		Summer Break	
July	3	M		Break	
July	5	W		Review	
July	7	F		Exam 2	
July	10	M	19	Transient Systems (Unsteady Flow)	https://youtu.be/zW3I7IDyosE https://youtu.be/3JU_PyXSMOE https://youtu.be/0Osf_peMbg0 https://youtu.be/0JAbIbEra0o
July	12	W	20	2nd Law Intro and Power Cycles	https://youtu.be/SOpSbCxmaAc https://youtu.be/-EQ5cVq-tWU https://youtu.be/YRPFM1S4YJ8 https://youtu.be/wzF3N9c7wRA
July	14	F	21	Refrigeration and Heat Pumps	https://youtu.be/uF4UGM6xMp8 https://youtu.be/nhmDGil-_Vc https://youtu.be/zav4R7DIwJE https://youtu.be/U2zgbQ5k0Oo
July	17	M	22	Reversibility and Carnot Cycles	https://youtu.be/8EcvFxJmFI4 https://youtu.be/0NuMdKuiA84 https://youtu.be/M_qz9i2Rr6s
July	19	W	23	Entropy as a Property	https://youtu.be/49Nbpcv4sVg https://youtu.be/99y2Q-EvMbE https://youtu.be/hoRXBkE3XcY

July	21	F	24	Reference Entropy and Specific Heats	https://youtu.be/kinE5eTVgQw https://youtu.be/0gUUejcsJ1Q https://youtu.be/cPLWt5TRJ2s https://youtu.be/nI73JIGWQE0
July	24	M	25	Isentropic Efficiency	https://youtu.be/K2A5gdROVZE https://youtu.be/pPkGtXqov6E https://youtu.be/qyuRukneC5I https://youtu.be/EqOS9aFl3Ao
July	26	W	26	Brayton Cycle	
July	28	F	27	Intercooling, Reheating, and Regenerators	
July	31	M	28	Otto Cycle	
August	2	W	29	Standard Diesel Cycle	
August	4	F	30	Rankine Cycle	
August	7	M		Review	
August	9	W		Exam 3	
August	11	F		Grades Finalized	

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/

Thermophysical Properties - https://webbook.nist.gov/chemistry/fluid/

NIST Chemistry WebBook - https://webbook.nist.gov/chemistry/

Python and Jupyter - https://www.anaconda.com/

Cantera - https://cantera.org/

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/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/.

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/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/.

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.html

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