METR 3210
ATMOSPHERIC THERMODYNAMICS
SPRING 2025

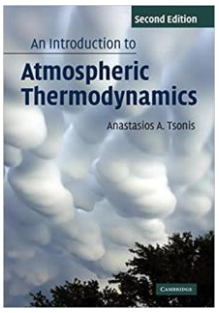
Instructor: Dr. Matthew Eastin
mdeastin@charlotte.edu

Class Time: Monday / Wednesday at 2:30 – 3:45 pm
Class Location: McEniry 118

Office: McEniry 209
Office Hours: Monday / Wednesday 9-10 am and 1-2 pm

Teaching Assistant: Roger Riggin
McEniry 426-J
rriggin@charlotte.edu

Text (Required): **An Introduction to Atmospheric Thermodynamics**
Anastasios A. Tsonis
Cambridge University Press
2nd Edition



Course Description: The study of the physical processes associated with atmospheric thermodynamics and stability. Topics include atmospheric composition, equation of state, hydrostatics, first and second laws of thermodynamics for dry, moist, and saturated air, atmospheric stability, parcel buoyancy, and thermodynamic diagrams.

Course Student Learning Objectives (SLOs):

1. Apply the first and second laws of thermodynamics to both dry and moist air parcels.
2. Calculate dry and moist air parcel parameters from standard observations.
3. Perform stability analyses using a Skew-T-log-P thermodynamic diagram.

Programmatic Student Learning Objectives (SLOs):

1. Develop sufficient knowledge to describe, analyze, and forecast the three-dimensional structure, evolution, and dynamics of the atmosphere. (Meteorology – SLO1)

Course Policies:

Attendance and Participation: Attendance is essential to maintaining an effective learning environment. Regular class attendance and participation are expected. Attendance will be taken twice each class – five minutes after the start of class (at 2:35 pm) and five minutes before the end of class (at 3:40 pm). You must be present both times to earn attendance credit for any given class day. **The use of smart phones, email, music players, headphones, earbuds, or any form of social media during class is strictly prohibited.**

Assignment Deadlines and Extra Credit: **You are expected to turn in assignments as scheduled,** except due to extraordinary circumstances or participation in a college-sanctioned event. Late assignments will not be accepted. There will be ***no individual extra credit***.

Exams: All examinations will be administered in the classroom on the scheduled date unless you have formal accommodation through the Office of Disability Services. If you miss an exam for what you believe to be a valid reason, you must provide written documentation (supporting the reason for your absence) before any consideration of a make-up exam is made.

Accommodation: Students seeking disability accommodation must first consult the Office of Disability Services and follow the instructions provided by that office for obtaining accommodation.

Academic Integrity: Students are responsible for knowing and following the UNCC Code of Student Academic Integrity https://legal.charlotte.edu/policies/up-407 and the UNCC Code of Student Responsibility https://legal.charlotte.edu/policies/up-406 in all aspects of their work in this course. This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity of academic dishonesty. Standards of academic integrity will be enforced in the course.

Course Etiquette: Open and mutually respectful communication of varied opinions, beliefs, and perspectives during classroom or online discussion encourages the free exchange of ideas that is essential to higher learning and to the ability to learn from each other. Students are expected to display tolerance for others' views and refrain from the use of any inappropriate language. Unwelcome conduct directed toward another person based upon that person's actual or perceived race, gender, color, religion, age, national origin, ethnicity, disability, or veteran status, or for any other reason, may constitute a violation of University Policy 406, The Code of Student Responsibility. Any student suspected of engaging in such conduct will be referred to the Office of Student Conduct.

Copyright: My lectures and course materials, including videos, presentations, tests, exams, outlines, and similar materials, are protected by copyright. I am the exclusive owner of copyright for all materials I create. I encourage you to take notes and make copies of course materials for your own educational use. However, you may not, nor may you knowingly allow others to reproduce or distribute lecture notes and course materials publicly without my express written consent; this includes providing material to commercial course material suppliers or other similar services. Students who publicly distribute or display, or help others publicly distribute or display, copies or modified copies of an instructor's course materials will be in violation of University Policy 406, The Code of Student Responsibility. Similarly, you own copyright of your work; if I wish to post your answers/papers on the course web site, I will request your written permission.

Course Requirements:

Class Participation: Each student is required to attend class and participate (take notes, ask questions, and complete in-class activities). Attendance will be taken twice during each class – five minutes after the start of class (at 2:35 pm) and five minutes before the end of class (at 3:40 pm). You must be present both times to earn attendance credit for any given class day. **Use of smart phones, email, music players, headphones, earbuds, or any form of social media during class is strictly prohibited**. Any student observed using such media during class (either during lecture or during in-class activities) will lose all attendance and participation points for that day.

Homework: A total of eight homework assignments will be given. Each homework assignment will consist of in-depth exercises related to current topics and concepts. You are required to show and/or explain your mathematical work on all homework assignments. **Access to a color printer [or the ability to modify/save (i.e., draw on) an image or PDF file is required]. A scientific calculator and colored pencils are required.**

Exams: All exams will be during class and closed notes/book. There will be two exams during the semester (on **February 26** and **April 9**) and a final exam (on **May 5**). The final exam day/time ***may not*** be rescheduled; plan your semester conclusion to accommodate the university-designated final exam date/time (see https://ninercentral.charlotte.edu/courses-registration/registration-resources/exam-schedules/).

Evaluation:

Your final grade will be calculated using the following point distribution and standard percentile scale:

		Percent	Grade
Attendance and Participation	40	90-100	A
Homework (8 @ 20 pts. each)	160	80-89	B
Mid-Term Exams (2 @ 50 pts. each)	100	70-79	C
Cumulative Final Exam	100	60-69	D
		0-59	F
Total Points	400		

Tentative Class Schedule:

Week	Date		Subject	Reading
1	Mon	1/13	**No Class – AMS Annual Meeting**	
	Wed	1/15	**No Class – AMS Annual Meeting**	
2	Mon	1/20	**No Class – MLK Day**	
	Wed	1/22	Introduction to the Course	Chapter 1
			Atmospheric Vertical Structure and Thunderstorms	
3	Mon	1/27	Equations of State and Gas Laws	Chapters 2 and 3
	Wed	1/29	Equations of State and Gas Laws	
4	Mon	2/03	First Law of Thermodynamics	Chapter 4
	Wed	2/05	First Law of Thermodynamics	
5	Mon	2/10	Adiabatic Processes	
	Wed	2/12	Adiabatic Processes	
6	Mon	2/17	Thermodynamic Diagrams	Chapters 9.2 and 9.3
	Wed	2/19	Thermodynamic Diagrams	
7	Mon	2/24	Review	
	Wed	2/26	**Exam 1**	
8	Mon	3/03	**No Class – Spring Break**	
	Wed	3/05	**No Class – Spring Break**	
9	Mon	3/10	Second Law of Thermodynamics	Chapter 5
	Wed	3/12	Second Law of Thermodynamics	
10	Mon	3/17	Phases of Water and Latent Heats	Chapter 6.1 and 6.2
	Wed	3/19	Phases of Water and Latent Heats	
11	Mon	3/24	Clausius-Clapeyron Equation	Chapters 6.3 and 6.4
	Wed	3/26	Clausius-Clapeyron Equation	
12	Mon	3/31	Water Vapor in the Atmosphere	Chapter 7
	Wed	4/02	Water Vapor in the Atmosphere	
13	Mon	4/07	Review	
	Wed	4/09	**Exam 2**	
14	Mon	4/14	Hydrostatics	Chapter 8.1
	Wed	4/16	Parcel Buoyancy and Atmospheric Stability	Chapter 8.2
15	Mon	4/21	Parcel Buoyancy and Atmospheric Stability	
	Wed	4/23	Stability Indices	
16	Mon	4/28	Stability Indices	
	Wed	4/30	Course Review	
17	Mon	5/05	**Cumulative Final Exam (2:00 – 4:30 pm)**	