CLIM 429 Atmospheric Thermodynamics – Fall 2024
TR 10:30-11:45am – Research Hall 121 "*The Climate Lab*"

Instructor: Paul Dirmeyer pdirmeye@gmu.edu
Office Hours: Thu 11:45-1:00 or by appointment

Catalogue Description:
Thermodynamics of the atmosphere, properties of dry and moist air, air parcel as a thermo-dynamic system, atmospheric stability and convection, cloud formation and stability indices

Course Objectives:
1. Develop an understanding of atmospheric thermodynamic processes.
2. Acquire the mathematical skill and physical principles of atmospheric thermodynamics.
3. Apply the mathematical skill and physical principles to solving atmospheric thermodynamics problems.

Prerequisites: CLIM 111 and MATH 114, or permission of instructor

Grading: Homework: 35%, Mid-term: 25%, Final: 35%
There are 7 HW problem sets. Each set carries 5% of total grade. HW problems are due on the date as indicated in the syllabus @11:59PM. Late submission will be accepted only in case of sickness, or pre-approval by the instructor at least two days before due day. You get a *second chance* on all homework – after graded homework is returned, resubmit up to the day before the Final Exam for an improved grade!

Grading Scale: Final grade out of 100 points

A+	A	A-	B+	B	B-	C+	C	C-	D	F
≥97	<97;≥93	<93;≥90	<90;≥87	<87;≥83	<83;≥80	<80;≥77	<77;≥73	<73;≥70	<70;≥60	<60

Course Textbook (required reading in advance of each class – see syllabus):
Petty, G. W., 2008: *A First Course in Atmospheric Thermodynamics*, Sundog Publishing, 334pp
This book is in the GMU bookstore, or may be purchased directly from the publisher Sundog Publishing, LLC or through on-line booksellers.

Prior to First Day of Class:
Read and understand the Appendices of the textbook!

Bring to Class:
Calculator (or calc app); laptop computer; a way to take notes; your brain! ☺

Other Course Resources:
A blank *Skew-T log-P* diagram is attached at the end of this syllabus.
Atmospheric sounding website: http://weather.uwyo.edu/upperair/sounding.html
AMS glossary of meteorology: http://glossary.ametsoc.org/wiki/Main_Page

Syllabus and Schedule (subject to change)

Week	Topics	Reading	Homework Due
1 (Aug 27, 29)	Atmospheric composition and structure; Thermodynamic systems and variables	Section 1.1-1.4; 2.1-2.2	
2 (Sep 3, 5)	Physical properties of air	3.1-3.3	Ch1 (Tue)
3 (Sep 10, 12)	Moisture in the air	3.4-3.5	
4 (Sep 17, 19)	Hydrostatic balance; Ideal Atmospheres	4.1; 4.2	Ch3 (Tue)
5 (Sep 24, 26)	Pressure in practice; Pressure-volume work	4.3; 5.1	
6 (Oct 1, 3)	First law of thermodynamics, Dry adiabatic processes; Mid-term review	5.2-5.4	Ch4 (Tue)
7 (Oct 8, 10)	**Mid-term**; Carnot cycle	5.5	
8 (Oct 17)*	Reversible processes, Enthalpy	5.6-5.7	
9 (Oct 22, 24)	Entropy, Second law; Moist processes	5.8, 6.1-6.2; 7.1-7.2	Ch5 (Thu)
10 (Oct 29, 31)	Clausius-Clapeyron; Moisture variables	7.3; 7.4-7.5	
11 (Nov 5, 7)	LCL, HCF; Moist adiabatic lapse rate	7.6; 7.7	Ch7i (Thu)
12 (Nov 12, 14)	Equivalent potential and wet-bulb temperature	7.8; 7.9-7.10	
13 (Nov 19, 21)	Atmospheric stability	8.1-8.4.1	Ch7ii (Thu)
14 (Nov 26)	Atmospheric convection; stability indices	8.4.2-8.5	
15 (Dec 3, 5)	Fun with profiles & boundary layer meteorology; Review		Ch8 (Thu)
Dec 17**	**Final Exam** 10:30am to 1:10pm	Emphasis on Ch 5-8	

*Fall Break – no class on Oct 15.

Homework sets and exams will be administered using [Gradescope](), which allows you to scan and uploaded hand-written assignments.

Homework Assignments [number of problems]:

Ch1: 1.1, 1.2, 1.3, 1.4, 1.5 [5]
Ch3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.10, 3.11 [8]
Ch4: 4.2, 4.4, 4.5, 4.6, 4.9, 4.15, 4.16 [7]
Ch5: 5.3, 5.4, 5.5, 5.6, 5.8, 5.10, 5.11, 5.12 [8]
Ch7i: 7.1, 7.2, 7.4, 7.6, 7.8, 7.9, 7.10, 7.11   [8]
Ch7ii: 7.13, 7.16, 7.21, 7.22, 7.23, 7.24 [6]
Ch8: 8.2, 8.4, 8.5, 8.6, 8.7, 8.9 [6]

Post-Chapter Surveys:

After each chapter, a survey will be distributed on Blackboard for you to provide feedback on the teaching and textbook. Bonus points towards the final grade will be given for responding.

Accommodations for Disabilities

If you have a documented learning disability or other condition that may affect academic performance you should: 1) contact the Office for Disability Services (SUB I, Rm. 2500; (703) 993-2474) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs. In addition to providing me with the appropriate form, please take the initiative to discuss accommodation with me at the beginning of the semester and as needed during the term. Because of the range of learning differences, we faculty members need to learn from you the most effective ways to assist you.

Academic Integrity

GMU is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously, and violations are treated gravely. Discussions about coursework inside and outside of the classroom with me or your fellow students are encouraged, and you may study together. However, copying HW directly from one another is prohibited. ChatGPT and other generative AI resources won't be very useful for homework assignments in this class – you should think for yourself. Cheating during exams is a violation of the code and will be reported to the university for appropriate action.
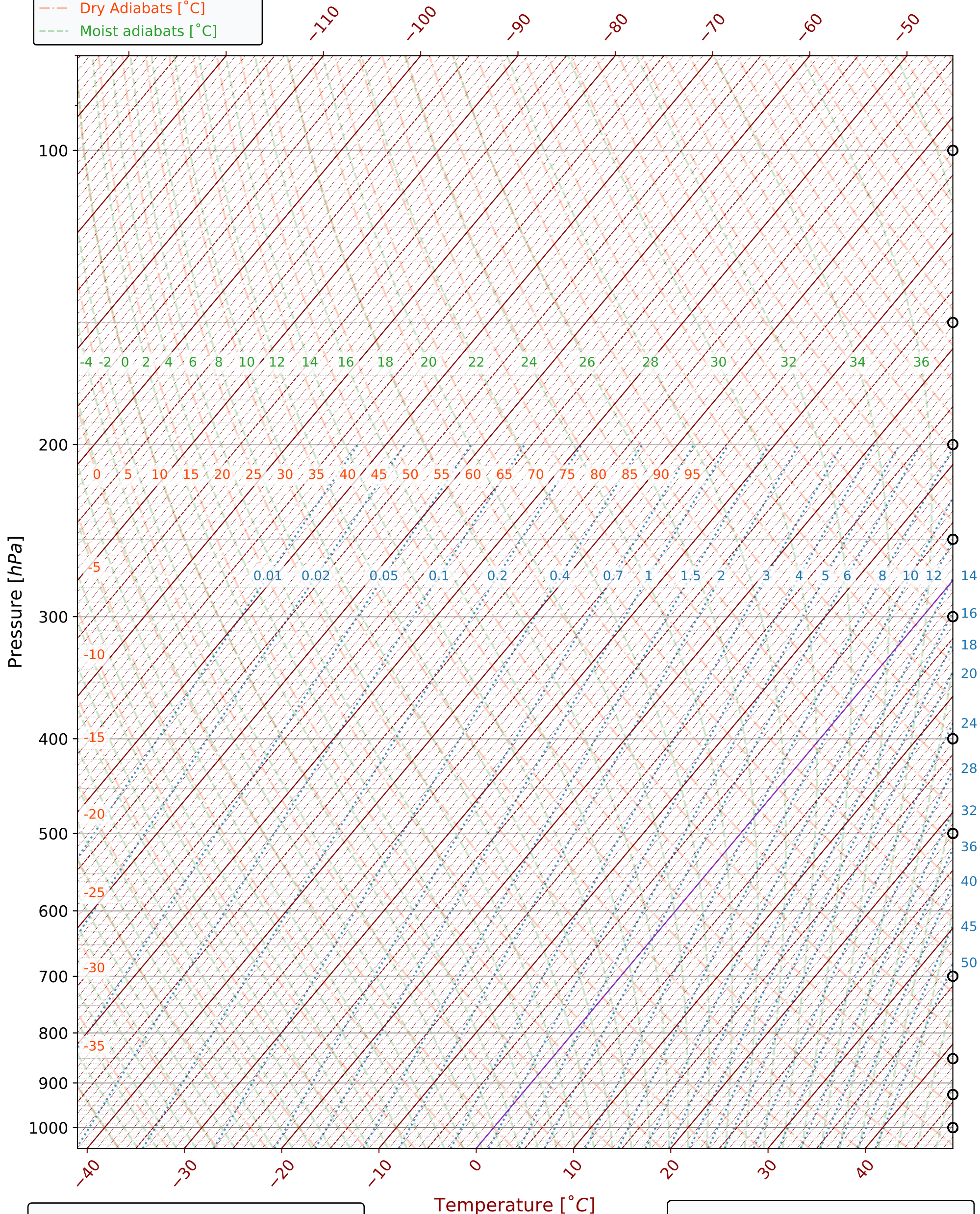
Inclusivity

Tolerance of your fellow humans is expected in this class and in the University as a whole. Mason has been a model in the Commonwealth of Virginia, and we should take great pride in our 21st Century vision. Racism and other forms of bias are divisive and destructive – in this course you will become aware of our common place in nature, and how diversity in background, abilities, interests and viewpoints makes society better for us all.

Skew-T log-P

Thermodynamic Quantities
— Pressure Levels
— Temperature, Dew Point
···· Mixing Ratio [g/kg]
—·— Dry Adiabats [$°C$]
--- Moist adiabats [$°C$]

AOES Atmospheric, Oceanic, and Earth Sciences

GEORGE MASON UNIVERSITY

Temperature [$°C$]

Pressure [hPa]

Temperature [$°C$]

Name: _____

Station: _____

Time: _____ Date: _____

LCL:_____hPa   CCL:_____hPa

LFC:_____hPa T_c: _____°C

EL: _____hPa T_w: _____°C