Syllabus
METR 3213: Physical Meteorology I
MWF, 1100-11:50, NWC 1350
Fall 2014

Instructor:	Prof. Phillip Chilson (`chilson@ou.edu`)
	Office: NWC 4618, 325-5095, Office Hours: M 2:00-3:00 PM & W 12:00-1:00 PM
	Feel free to come outside of office hours if my door is open
Teaching Assistant:	Andrew Mahre (`andrew.mahre@ou.edu`)
	Office: NWC 5110, Office Hours: TH 11:00 AM-12:00 Noon
Text:	*A First Course in Atmospheric Thermodynamics*,
	Grant W. Petty, Sundog Publishing, 2008
Pre-requisites:	Grade of C or better in MATH 2443, PHYS 2524, and METR 2023/2021

Course Overview: This course introduces the physical processes associated with atmospheric composition, basic radiation and energy concepts, the equation of state, the zeroth, first, and second law of thermodynamics, the thermodynamics of dry and moist atmospheres, thermodynamic diagrams, statics, and atmospheric stability.

Planned Course Content

I. Atmospheric Composition and Structure Pressure and density; Hydrostatic balance; Atmospheric density; Composition; Temperature; Zeroth law of thermodynamics; and Atmospheric temperature profiles.

II. Thermodynamic Systems and Variables Air parcels; System variables; State and process variables; Conserved variables; and Extensive and intensive variables.

III. Physical Properties of Air Equation of state; Experimental properties of gases; The gas laws; Dry air gas constant; Equation of state for moist air; Mixing ratio and specific humidity; Virtual temperature; and Buoyancy calculations.

IV. Atmospheric Pressure Hydrostatic balance; Hydrostatic equation; Geopotential height; Hypsometric equation; Pressure profiles of idealized atmospheres; and The U.S. standard atmosphere.

V. The First Law of Thermodynamics The first law of thermodynamics; Internal energy; Heat capacity; Poisson's equations; Potential temperature; Dry adiabats; The dry adiabatic lapse rate; Heat engines; The carnot cycle; Reversible and irreversible processes; Enthalpy; and Diabatic processes.

VI. The Second Law and Its Consequences Entropy; and Thermodynamic equilibrium.

VII. Moist Processes Water vapor saturation; saturation vapor pressure; relative humidity; Dewpoint; Latent heat of condensation / vaporization; The Clausius-Clapeyron equation; Saturation mixing ratio; Moisture variables on the skew-T diagram; Lifting condensation level (LCL); Moist adiabatic lapse rate; Equivalent potential temperature; and Wet-bulb temperature.

VIII. Atmospheric Stability The parcel method; Stable and unstable systems; Local (static) atmospheric stability; dry static stability; Brunt-Vaisala frequency; Potential instability; Parcel stability and atmospheric convection; and Stability indices.

Supplemental Material (Strongly Encouraged and Recommended)*:

Strongly Encouraged
Sometimes it is helpful to consult materials outside the required textbook in order to better understand and appreciate some of the concepts being presented during the course. To that end, I will be providing supplemental reading and study material for this course, which will be provided through the class home page (`https://learn.ou.edu/`). These materials are considered part of the assigned reading material. **It is the responsibility of the student to regularly access the class home page and check for the availability of new material.**

Recommended
In addition to the materials that will be provided via the class home page, you may find the following books useful. These readings are considered as voluntary. They are listed in order of increasing difficulty.

- *Atmospheric Science: An Introductory Survey, 2nd Ed*, J. M. Wallace & P. V. Hobbs, Academic Press, 2006 (Chapter 3): This material is highly relevant to the material being presented in class and provides many examples. Some of the supplemental material is inspired from this book.
- *An Introduction to Atmospheric Thermodynamics, 2nd Ed*, A. A. Tsonis, Cambridge University Press, 2007: This book is very relevant to the material being presented in class but is slightly more theoretical in nature. Again, some of the supplemental material is inspired from this book.
- *Atmospheric Thermodynamics*, C. F. Boren & B. A. Albrecht, Oxford University Press, 1998: This book is clearly intended for the more serious student. It goes deeper into the subtleties of thermodynamics. It is a good reference if you really want to know what is going on (thermodynamically) in the atmosphere. The mathematics is not more advanced, but the treatment of thermodynamics goes deeper.
- *Thermodynamics*, E. Fermi, Dover Press, 1936: I have included this book because it is an excellent text on general thermodynamics from a Nobel Prize winning physicist. Enrico Fermi was a brilliant theoretician and experimentalist. His treatment of thermodynamics is both illuminating and comprehensive. Again, the mathematics is not overly complex.

(*): Please note that I have intentionally refrained from using such words as "required" or "mandatory" in connection with the supplemental material. This could equally apply to other aspects of the course. You are not "required" to read the book, attend the lectures, or do the homeworks. You are invited and encouraged to do these things in order to advance in your studies of meteorology. I plegde to do my best to provide opportunities for you to expand your knowledge of atmospheric thermodynamics; but, I want you to know that you are an active part of the class (not just a bystander). Therefore, I encourage you to take an active role in your investigation and discovery of meteorology.

Class Homepage:
The class home page will be available through Desire2Learn (`https://learn.ou.edu/`)

Examinations, Quizzes, and Programming Assignments:
In our society, testing is a necessary part of assessing how well a student has mastered various components of any subject area. To that end, there will be 11 quizzes, 3 exams, 6 programming assignments, and 1 comprehensive final exam given during the course of the semester. See the "Tentative Schedule of Exams, Quizzes, Assignments, and Breaks" provided with this syllabus.
Quizzes: These will be given during the first 10 minutes of class on the designated days. Quizzes will be based on the homework sets assigned during the semester. Often the quiz question will be taken verbatim from the homework (only the numbers used in the calculations will be different). Solutions to the homework will be available to you before taking the quiz.
Programming Assignments: The assignments will consist of calculations and analysis of thermodynamic quantities and scenarios using MATLAB, which is available on the School of Meteorology computing facilities. Programming assignments will be deposited to the Dropbox on the class web page. You can turn in the assignment late by emailing it to me, but your grade will be lowered by 20% for each day that it is late.
Exams: One complete class period will be allotted for each exam given during the regular semseter. If arrangements can be made, then I will try and allow extra time for taking the exams.
Final Exam Two hours have been allocated for the final exam. The exam will be comprehensive.

Grading:
There will be 11 quizzes given during the semester. You are allowed to drop one quiz grade. The remaining 10 will be averaged and the result will contribute 20% towards your final grade. There will be 4 programming assignments and the average grade will contribute 15% towards your final grade. There will be 3 exams given during the semester and the average will contribute 40% towards your final grade. The comprehensive final exam will contribute 25% towards your final grade. That is:

Quizzes (11)	20%
Programming Assignments (4)	15%
Examinations (3)	40%
Comprehensive Final Examination (1)	25%

$$\text{Final Grade} = 0.20 \cdot \text{Quiz Avg} + 0.15 \cdot \text{Prog Avg} + 0.40 \cdot \text{Exam Avg} + 0.25 \cdot \text{Final Exam Grade}$$

Grade distribution:
The following table provides the "target" grade distribution

Final Numeric Grade	**Final Letter Grade**
90 – 100%	A
80 – < 90%	B
70 – < 80%	C
60 – < 70%	D
< 60%	F

I do reserve the right to lower numerical thresholds for a given letter grade.

Make-up Policy:
No unexcused make-ups for the quizzes or exams or extension on the programming assignments will be given. It is YOUR responsibility to notify me if cannot or were not able to take an exam or quiz or make an assignment deadline.

Tentative Schedule of Exams, Quizzes, Assignments, and Breaks

September	01	Monday	Labor Day ... no class
	05	Friday	Quiz 1 & Quiz 2
	12	Friday	Quiz 3
	17	Wednesday	Programming Assignment 1 Due
	19	Friday	Quiz 4
	26	Friday	Exam 1
October	03	Friday	Quiz 5
	06	Monday	Programming Assignment 2 Due
	08	Wednesday	Quiz 6
	10	Friday	"Fall Holiday" ... no class
	17	Friday	Quiz 7
	24	Friday	Exam 2
	29	Wednesday	Programming Assignment 3 Due
	31	Friday	Quiz 8
November	07	Friday	Quiz 9
	14	Friday	Quiz 10
	17	Monday	Programming Assignment 4 Due
	21	Friday	Exam 3
	26	Wednesday	Thanksgiving Break ... no class
	28	Friday	Thanksgiving Break ... no class
December	05	Friday	Quiz 11
	11	Friday	Final Exam, 1:30 - 3:30 PM

Academic Honesty: Homework assignments are important for your understanding of the material. Occasional help from a classmate is fine but be sure that you actually understand the material. It will help tremendously for you to come visit me in my office hours. Realize that simply copying a homework assignment from any source is considered cheating and will definitely not help your understanding. If caught, such activity could result in a failing grade in the course and possible disciplinary action. All students are expected to be familiar with and abide by the OU Academic Misconduct Code. Information on this code and other student policies is located at `http://studentconduct.ou.edu`.

Religious Holidays: It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays.

Reasonable Accommodation Policy: The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. Students with disabilities must be registered with the Office of Disability Services prior to receiving accommodations in this course. The Office of Disability Services is located in Goddard Health Center, Suite 166, phone 405/325-3852 or fax only 405/325-4173.