University of Wyoming, Department of Atmospheric Science
ATSC 5010 Physical Meteorology I
(Thermodynamics and Radiative Properties of the Atmosphere)
Fall 2017
Course Syllabus, Policies and Outline

1 Instructor

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http://www.atmos.uwyo.edu/~jfrench/teaching.html

2 Course Goals and Objectives

Goal: The goal of this course is for students to gain an advanced understanding of the application of basic thermodynamic principles to the atmosphere and to understand basics of atmospheric radiation and the interconnection between the two (radiation drives the energetics of the earth). This course is the cornerstone for further study of *Physical Processes* in the atmosphere.

Objectives: Specific objectives of this course are as follows:

- Using equations of state, describe the relationship between basic state parameters in the atmosphere
- Investigate use of the first and second laws of thermodynamics to address adiabatic processes (dry) in the atmosphere
- Introduce thermodynamics of water substance and variables that are used to describe water in the atmosphere
- Apply the above principles and understanding to moist thermodynamic processes in the atmosphere including phase changes; introduce the concept of static stability, understand how moisture modifies stability considerations
- Understand the basics of solar and terrestrial radiation
- Investigate radiative emission and its applicability to the earth's atmosphere; further examine concepts related to transmission, absorption, and scattering applied to the atmosphere
- Apply the above concepts to transmission, scattering and absorption in clouds.

3 Course Prerequisites

Calculus III; Calculus-based Physics II

It is assumed that students taking this class are familiar with basics of simple differential equations, separating differentials, integrating limits, etc. Students are also expected to have been introduced to the laws of thermodynamics and governing equations and basic concepts. We will review these concepts and apply them specifically to problems in the atmosphere.

4 Course Structure

Material for this course is taught through both lecture and computer laboratory sessions. It consists of three 1-hour lectures per week and one 3-hour laboratory session. The laboratory work is tightly coupled with lecture topics and will re-enforce learning for the student to be successful in the homework, quizzes, and exams.

5 Grading

a. Breakdown of graded events

Grading will be based on homework, quizzes and exams. The majority of your grade will be based on 3 exams.

	WEIGHT
Exam 1	20%
Exam 2	20%
Exam 3	20%
Laboratory Problems	25%
Lecture Homework	5%
Quizzes	10%
TOTAL	100%

b. Homework, Quizzes, and tests

Homework will not be graded *explicitly*. Students will receive a grade for turning in homework and putting forth an effort in completing the work. Homework is the student's opportunity to learn the material and identify if there are aspects of the learning that need more attention.

Quizzes will be given every other week. Quizzes provide opportunities for both the student and the instructor to evaluate how well the material is understood. Quizzes

also provide the student a 'glimpse' at the type of questions that will be asked on exams and will focus on the most important concepts taught in the class.

All Exams will be given during normal class hours, roughly 1/3 and 2/3 through the semester (see schedule). The last exam will *emphasize* the material taught during the last 3rd of the class, but it is inclusive of all material taught during the semester and one should expect problems that focus on synthesizing material from throughout the semester.

c. Laboratory Problems

Each week a specific Laboratory problem will be assigned. The problems will require use of computer and specific computer language (IDL) to solve. These problems will be tightly coupled with lecture topics. The laboratory work should re-enforce what was taught in class. Grading is combined on the content of the work (programming), formulation of the solution, and interpretation. These sessions also introduce the student to the use of a specific scientific computer language (IDL) that will be used throughout the student's academic career in this department.

d. Grading Scale

The Department of Atmospheric Science has adopted the University of Wyoming +/- grading system. The breakdown is as follows:

Letter Grade	**Percentage Range (%)**	**Equivalent GPA (4.0 scale)**
A	93 – 100	4.00
A-	90 – 92	3.67
B+	87 – 89	3.33
B	81 – 86	3.00
B-	80 – 80	2.67
C+	77 – 79	2.33
C	71 – 76	2.00
C-	70 – 70	1.67
D+	67 – 69	1.33
D	60 – 66	1.00
F	Below 60	0.00

Note: the university mandates that graduate students maintain a cumulative GPA of 3.00 or better. Failure to do so will result in academic probation and could lead to expulsion from the program.

6 Textbook and supplementary material

Two textbooks will be *required*:

Curry and Webster (1999) is *required*. The portion of the course focusing on Thermodynamics will follow quite closely the presentation order of the material in this book.

Petty (2006) is *required*. Topics in radiation will be taken primarily from this text.

Other texts that are *optional* include:

Iribarne and Godsen (1981), *out of print.* This book is useful for detailed derivation of equations and a basic understanding of *advanced* thermodynamic principles applied to the atmosphere.

Bohren and Albrecht (1998). This book provides a different approach to the study of thermodynamics of the atmosphere. This can be a fun book to read—but the tangents can also be distracting at times.

Salby (2012). This book covers a multitude of topics in Atmospheric Science including thermodynamics and radiation. Most of the concepts covered in this class are included to some degree within this text.

7 Overview of Policies

a. Turn-in Policy

To obtain credit for your homework, it must be turned in on time.

(*Homework*) Typically, there will be one homework assignment every two weeks. It will be due usually ~1 week after it was assigned.

(*Labs)* There will be one lab assignment per week. Lab assignments will often require additional time (beyond the ~3 hour lab section) to complete. **Labs are due by 3 PM on Friday**. Labs turned in late will receive a 50% reduction. Labs not turned in by Monday at 8 AM will receive a zero.

b. Quizzes & Attendance

For excused absences, students will have an opportunity to make-up missed quizzes, or depending on the circumstances, the quizzes may be excused altogether. The decision will be made on an individual basis by the instructor.

If students know they will miss class (Dr. appointment, conference, etc) during a scheduled quiz section, they **must** contact the instructor ahead of time to arrange a makeup quiz. Unexcused absences will result in a zero grade for that quiz.

Students are encouraged to take advantage of opportunities offered by the department: flying on the UWKA, attending conferences, participating in field program. However—make sure you arrange ahead of time with your instructor if you will miss class.

c. Collaboration Policy

To solve the homework assignments, you are encouraged to work with other students currently enrolled in ATSC5010. You must, however, document any of the help you receive in the form of comments directly on your homework paper or within your program. No comments mean you are submitting the item totally as your own work; my assumption will always be that you are an honorable person unless you cause me to believe otherwise. Simply copying another person's assignment is not allowed – the actual item you turn in must ultimately be your own work. You may be called to your instructor's office with no advance notice to explain in detail the specifics of your work.

Quizzes and exams must always be the student's own work.

d. Academic Honesty

"The University of Wyoming is built upon a strong foundation of integrity, respect and trust. All members of the University community have a responsibility to be honest and have the right to expect honesty from others. Any form of academic dishonesty is unacceptable to our community and will not be tolerated." [excerpted from the UW General Bulletin] All persons should report suspected violations of standards of academic honesty to the instructor, department head, or dean. See UW Regulation 6-802, "Procedures and Authorized University Actions in Cases of Student Academic Dishonesty." You can read this and all other University regulations at: http://www.uwyo.edu/generalcounsel/index.html

e. Disability Statement

If you have a physical, learning, or psychological disability and require accommodations, please let the instructor know as soon as possible. You must register with, and provide documentation of your disability, to University Disability Support Services (UDSS) in SEO, room 330 Knight Hall.

8 Schedule and Course Topics *(Subject to Change)*

State Variables, Equation of State, Hydrostatic Equilibrium (1.1, 1.3 – 1.7, 1.10)

Heat, First Law of Thermodynamics (2.2 – 2.4)

Quiz I – September 8

Entropy, Second Law of Thermodynamics (2.5 – 2.6)

Adiabatic Processes (2.10)

Quiz II – September 22

Water substance, humidity variables (4.1 – 4.4)

EXAM 1 – October 2

Moist/Saturated Processes and Phase change; ice processes (6.1 – 6.6)

Quiz III – October 13

Conserved variables and Thermodynamic diagrams (6.7 – 6.8)

Static Stability and Buoyancy (7.1 – 7.3)

Quiz IV – October 27

Properties of Radiation (Petty 2.1-2.8)

EXAM 2 – November 6

SW and LW Radiation and the Electromagnetic Spectrum (Petty 3.1-3.4)

Thermal Emission, Blackbody radiation, Stefan-Boltzmann Law (Petty 6.1–6.4)

Quiz V November 17

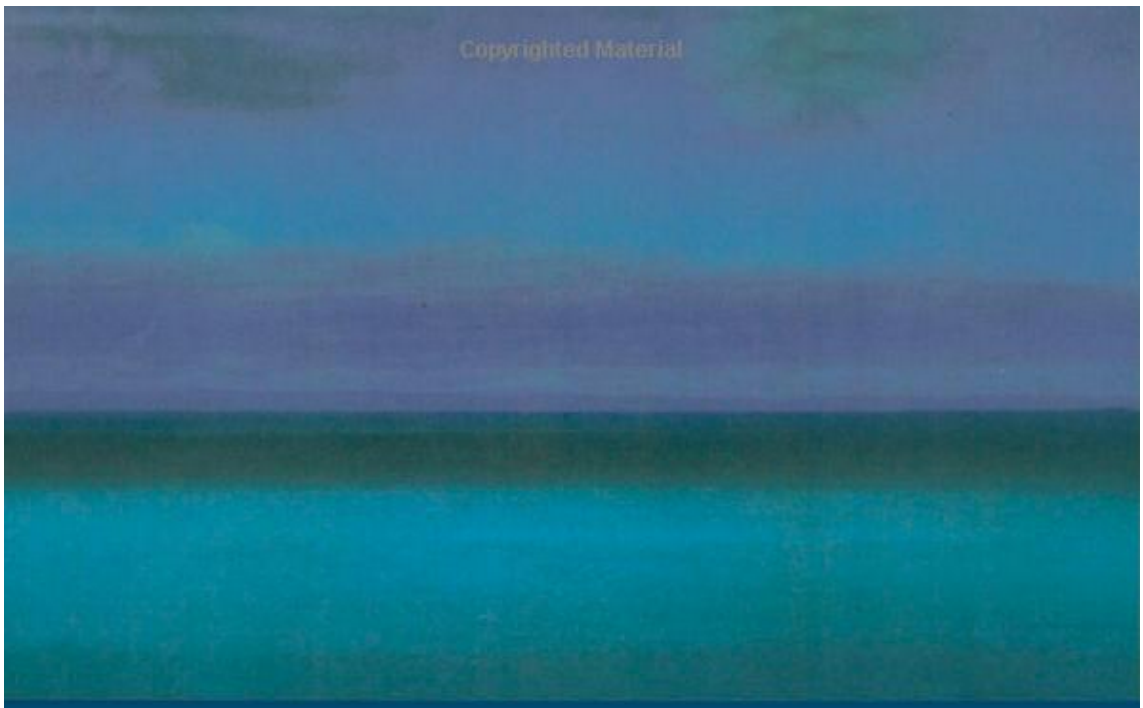
Radiative Transfer in the Atmosphere: Extinction, Scattering and Absorption (Petty 7.1-7.3, 7.4.1-7.4.3)

Absorption by Gases in the Atmosphere (Petty 9.1, 9.3-9.4)

Scattering and Absorption by Particles (Petty 12.1-12.3, 12.5)

Quiz VI December 8

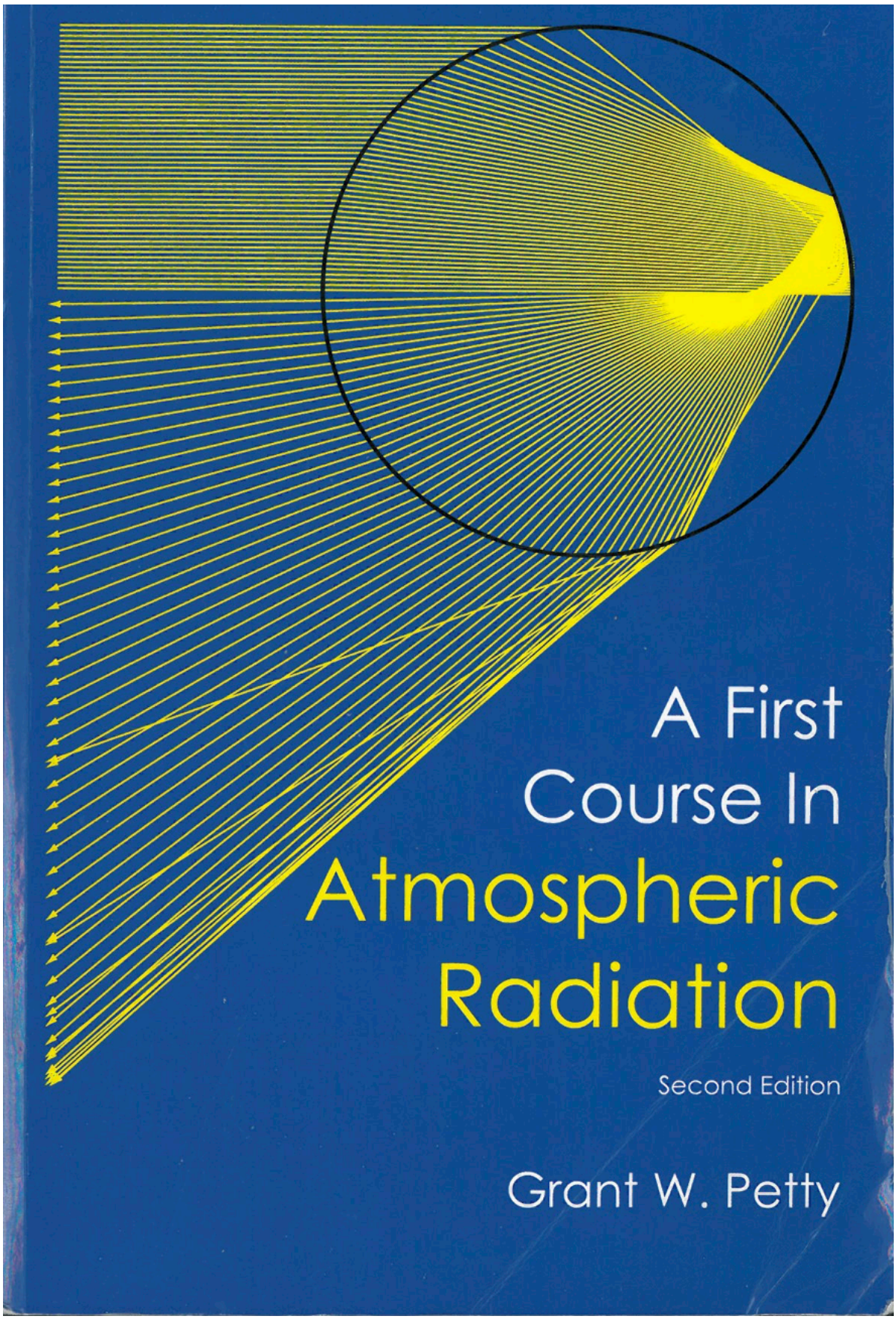
EXAM 3 – Finals Week



Thermodynamics of Atmospheres & OCEANS

JUDITH A. CURRY & PETER J. WEBSTER

INTERNATIONAL GEOPHYSICS SERIES, VOLUME 65


A First
Course In
Atmospheric
Radiation
Second Edition
Grant W. Petty

PHYSICS *of the* ATMOSPHERE *and* CLIMATE

MURRY L. SALBY

ATMOSPHERIC THERMODYNAMICS

Craig F. Bohren
Bruce A. Albrecht

Geophysics and Astrophysics Monographs

Atmospheric Thermodynamics

J. V. Iribarne and W. L. Godson

D. Reidel Publishing Company