ATMS 411/611 Fall 2019
Introduction to Atmospheric Physics

Taught by: Professor W. Patrick (Pat) Arnott.

Time and Place: Mon/Tues/Wed/Thur 8:00am to 8:50 pm. DMS 106 and online.

Textbook: Atmospheric Science: An Introductory Survey by Wallace and Hobbs.

Supplemental Textbook (not required but helpful): A First Course in Atmospheric Thermodynamics by Grant W. Petty.

Office hours: Wednesdays from 1 - 3 pm, RM 213 Leifson Physics, and at other times by appointment.   Please feel free to take advantage of them.

Contact: arnottw@unr.edu, 775-784-6834.

Course Administration: webcampus for grades and some assignments.
Daily notes and course coordination will be through my website.

Catalog Description: Atmospheric structure; global radiation balance; radiation scattering by gases and aerosol particles; introduction to radiation transfer; optical phenomena; atmospheric thermodynamics; cloud physics; aerosol mechanics; atmospheric electricity. Prerequisite: PHYS 181.

Final Exam: Thursday December 12th from 9:50 am to 11:50 am.

Student Learning Outcomes:
1. Demonstrate ability to work with the thermodynamic structure of the Earth's atmosphere from the surface through the troposphere, stratosphere, mesosphere, thermosphere, and ionosphere: The origin of the atmosphere. Loss of atmospheric gases at the top of the atmosphere and gain of atmospheric constituents from space.

2. Demonstrate ability to use skew-T logP thermodynamic diagrams for the atmosphere, the foundation for each curve on this plot, and uses for understanding weather conditions.

3. Demonstrate ability with aerosol and cloud microphysics, and the connections between them, atmospheric thermodynamics, and radiation transfer.

4. Demonstrate ability to use atmospheric radiation transfer, including solar radiation, infrared radiation, single and multiple scattering, light scattering by aerosols and cloud hydrometeors, the factors affecting the Earth's radiation balance, the role of radiation in weather and boundary layer dynamics, and the

precise meaning of the greenhouse effect. Some questions we will explore are these: why are clouds white, skies blue, what would the sky look like if you could see at infrared wavelengths, and why it matters.

Planned Schedule of Topics:

Week 1 Overview of Atmospheric Science, chapter 1 and presentation. Homework 1 discussion. Introduction to skew T log P diagrams. Exponential model for pressure and density variation with height. Use of local weather stations at various altitudes for lapse rate and layer mass.
Week 2 Continuation of homework 1 data analysis. Begin chapter 3, Atmospheric Thermodynamics. Topics include a. Ideal gas equation applied to dry and moist air. b. Virtual temperature. c. Potential temperature. d. Hydrostatic equation. e. Increasingly detailed description of the temperature and pressure distribution in the atmosphere. f. SkewT logP diagrams. f-g. Relative humidity, absolute humidity. g. Dew point temperature. h. Wet bulb temperature. i. Equivalent potential temperature. j. Latent heat release and absorption in condensation and evaporation of water. k. Stability of air parcels. l. Indices on soundings.
Week 3. Continue with chapter 3. Students discuss atmospheric soundings. First homework assignment of Atmospheric Thermodynamics.
Week 4. Students present homework assignment 2. Atmospheric thermodynamics continues.
Week 5. Continue with atmospheric thermodynamics, measure dry and wet bulb temperatures and obtain Example: Measure the temperature and wet bulb temperature in the classroom. Then obtain the following: 1. Lifting condensation level. 2. Dew point temperature. 3. Relative humidity. 4. Potential temperature θ. 5. Wet bulb potential temperature θ_w. 6. Equivalent potential temperature θ_E.
Week 6. Students present homework on self-chosen sounding with large amounts of convective available potential energy (CAPE); group presentations on soundings, with calculations of the vertical distribution of potential temperature, equivalent potential temperature, and CAPE.
Week 7. Atmospheric stability; gravity waves, Brunt Vaisalla frequency.
Week 8. Midterm exam. Begin chapter 4 on Atmospheric Radiation Transfer. Students present assignment 4, conceptual aspects of atmospheric radiation.
Week 9. Scattering, absorption, and emission by hydrometeors, aerosols, and atmospheric gases. Single layer model for atmospheric radiation transfer.
Week 10. Scaling of atmospheric radiation interaction with wavelength and object size: Rayleigh, resonant (Mie), and geometrical optics regime. Blue sky and radar observations; rainbows.
Week 11. Multiple scattering of light by clouds. Single layer cloud and clouds above partially reflective surfaces. Role of surface energy budget and surface albedo.
Week 12. Section 5.4 of chapter 5 and chapter 6, cloud physics. Kelvin effect. Essential role of aerosol in cloud physics.
Week 13. Kohler theory. Formation mechanisms of cloud droplets and ice crystals. Observations.
Week 14. Atmospheric electricity: Fair weather electric field. Effects of clouds on electric fields.
Week 15. Hydrometeor charging. Lightning. Propagation of sound from thunder through the atmospheric. Acoustic shadow boundary
Final Exam

Grading: The class grade is determined as follows:

40% Homework: assigned problems; and quizzes given to reinforce class material and class attendance.
20% Online modules
40% Tests: Midterm, and Final Exam

Students can track their grade as the semester progresses using WebCampus. Semester grades will be given using the following percentage guide:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
90%-100%	89%-89.9%	88%-88.9%	80%-87.9%	79%-79.9%	78%-78.9%	70%-77.9%	69%-69.9%	68%-68.9%	60%-67.9%	59%-59.9%	0-58.9%

Midterm Exam: A mid-semester, cumulative exam to be administered in class [20% of final grade].

Final Exam: Cumulative exam to be administered in class [20% of final grade].

ATMS 611 students will have additional homework assignments and may have different exams than 411 students.

Policies regarding late work and make-up exams: Students must ask for any missing assignments or makeup work due to absences from the class. Students will be given one day for each day's excused absence to complete missing work. Late work will be accepted up to 5 days after the due date. After the fifth day, the assignment will be considered missing and receive a zero. Students who miss an exam without a legitimate excuse will automatically receive 0 points for that exam. The student is responsible to schedule the makeup-exam with the instructor.

GUIDE TO DOING WELL IN THIS CLASS:
(My observations of students that get the most out of their course work during this brief time in life when you get to be a student)

1. Attend class, every class. Ask questions in class. I benefit greatly from questions students ask in class as it helps me refine my understanding of the subject matter, and it helps me convey topics more effectively. Other students benefit as well. I am very open to questions in class, and find that when we have a discussion rather than a monologue, we all get a lot more out of our time together, and we can make interesting discoveries as we go along.

2. Do the homework every time, on time.

3. Work with others on the homework so that you learn to work in a group, and you gain the insights of others as they gain from you.

4. Be sure you thoroughly understand the homework and course material.

5. Read the textbook and supplemental textbook.

6. Arrange your daily schedule so that you have time for sleep at night, and can digest the course material daily. Work on each course a little each day.

7. Get started early on everything. It helps cement your knowledge.

8. Eat well, and get some exercise. Some diversions help refresh your enthusiasm and skill.

9. Attend office hours to ask questions and refine your understanding of the subject matter.

10. Seek connections with the subjects of this course and others you are taking or will take later on.

11. Pay close attention to subjects that are of great interest to you, and you may be able to link future employment and/or your thesis to the concepts of this course.

University Policies

Statement on Academic Dishonesty:

"Cheating, plagiarism or otherwise obtaining grades under false pretenses constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include filing a final grade of "F"; reducing the student's final course grade one or two full grade points; awarding a failing mark on the coursework in question; or requiring the student to retake or resubmit the coursework. For more details, see the University of Nevada, Reno General Catalog."

Statement of Disability Services:

"Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations."

Statement on Audio and Video Recording:

"Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."

Services for a Safe and Equitable Campus

Counseling and advocacy services are available through Counseling Services (775-784-4648) and the Equal Opportunity & Title IX office.
The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit the Equal Opportunity and Title IX page.

Statement for Academic Success Services

"Your student fees cover usage of the Math Center (775) 784-4433, Tutoring Center (775) 784-6801, and University Writing Center (775) 784-6030. These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student."