Atmospheres and Remote Sensing
PtyS 517 Fall 2004

Tuesday and Thursday from 9:30-10:45 a.m.

Occasional additional lectures may be arranged to make up for times when the instructor is out of town.

Space Sciences 312

Instructor: Adam Showman, Space Sciences 430, 621-4021
showman@lpl.arizona.edu
Office hours: After class or by appointment

Course Objectives: This course will provide an overview of the fundamental physical processes that govern the structure and behavior of atmospheres. The target audience is beginning graduate students in the planetary science department at the University of Arizona, although graduate students and advanced undergraduates from across the University are also welcome.

Approximate Outline:

Overview/statics [6 lectures]: Introduction to the current state and composition of atmospheres; description of air; basic thermodynamics; physics of vertical structure.

Radiative transfer [8 lectures]: the nature of radiation; absorption and scattering of radiation by gases and particles; equations of radiative transfer; thermal structure of atmospheres in radiative equilibrium; retrieval of information from spectra of atmospheres.

Dynamics [8 lectures]: Equations governing the motion of air; dynamical regimes; physics of large-scale motion; waves; response of atmospheres to radiative forcing; turbulence.

Clouds physics [3 lectures]: Cloud types; moist adiabats; condensation; physics of particle growth and sedimentation; effects of clouds on the structure and motion of atmospheres.

Putting it all together [4 lectures]: Application of the basic principles of statics, radiative transfer, dynamics, cloud physics, and chemistry to understand the diverse range of atmospheres in the solar system. A grand synthesis.

Textbook: *An Introduction to Atmospheric Physics* by David G. Andrews is the primary (required) text. I will not follow the textbook exactly, but it will provide important background reading. I will also put the following books on reserve in the planetary science library. Although they will not be required, you should be aware of their existence.

Overviews of atmospheric science

Atmospheric Science: An Introductory Survey by Wallace and Hobbs
Fundamentals of Atmospheric Physics by Salby
Principles of Atmospheric Chemistry and Physics by Goody
The Physics of Atmospheres by Houghton
Theory of Planetary Atmospheres by Chamberlain and Hunten

Radiative transfer:

An Introduction to Atmospheric Radiation by Liou
Atmospheric Radiation: Theoretical Basis by Goody and Yung

Dynamics:

An Introduction to Dynamic Meteorology by Holton
Atmosphere-Ocean Dynamics by Gill
Geophysical Fluid Dynamics by Pedlosky
Middle Atmosphere Dynamics by Andrews, Holton, and Leovy

Clouds and chemistry:

Microphysics of Clouds and Precipitation by Pruppacher and Klett
Atmospheric Chemistry and Physics: from Air Pollution to Climate Change by Seinfeld and Pandis
Photochemistry of Planetary Atmospheres by Yung and DeMore
Introduction to Atmospheric Chemistry by Hobbs

Prerequisite: The course is intended for introductory planetary science graduate students. Basic vector calculus and differential equations will be used, and basic familiarity with physics will be needed (some of this will be developed as we go along).

Grades: The grade will be based on several components, weighted as follows:

20% Homework
10% Critique of a published paper
25% Term Project
20% Midterm
25% Final

The critique of a published paper and the term project are important aspects of this course — my aim is to get you excited about being at the cutting edge of this field. The critique, which will be presented orally in front of the class, will help you develop critical thinking skills regarding the scientific literature. The term project will introduce you to planetary-atmospheres research, with the goal that your project could eventually be publishable.

The term project will require a short written paper. I will hand out a list of possible term projects to choose from (or feel free to choose your own).

Course policies:

Feedback: Please let me know how you think the course is going. Suggestions for improvements and ideas for things to try (e.g., topics or activities you'd like to see) are both welcome.

Auditors: I would like to encourage those students auditing this class to choose and carry out a term project. This is a good way of cementing the course material and could lead to research projects that we can continue after the class is over.

Late work: If an assignment is due, you are responsible for turning it in, even if you are absent. All assignments are due at the beginning of class on the due date. Any assignments turned in after that time will be considered late. I will try to be understanding, but I reserve the right to enforce the following policy: Late assignments turned in within one week of the due date will receive one-half credit, after which they will receive zero credit. Please talk to me if you think you can't finish an assignment on time.

Special needs: Students with disabilities who require reasonable accommodations to fully participate in course activities or meet course requirements must register with the Disability Resource Center. If you qualify for services through DRC, bring your letter of accommodations to me as soon as possible.

Academic Integrity: It is strongly recommended that all students read the *University of Arizona's Code of Academic Integrity.* All students in this course are expected to abide by this code, which will be strictly enforced. Cheating will not be tolerated in any form. Submission of any written work that partially or fully duplicates material from the web, your fellow students, or any other source constitutes plagiarism. Students are encouraged to work together on the homework sets, but unique written responses must be handed in by each student. Instances of plagiarism will lead to a zero on that assignment, with harsher penalties for repeat offenses or extreme cases. Plagiarism on the midterm, final exam, or term-project write-up will lead to a failing grade for the course.