

Meteo 437 -- Atmospheric Physics II (Cloud Physics) – Spring, 2005

Instructor: William H. Brune
504 Walker Building
865-3286
brune@ems.psu.edu

Office Hours: Monday, Wednesday: 11:00 - 12:00, and by appointment (You can come by. If I can see you at that moment, I will. If not, we can schedule an appointment.)

Lectures: Monday, Wednesday, Friday
10:10 – 11:00
103 Leonhard Building

Teaching Assistant: D. Matt Coleman
Office: 530 Walker
Office Hours: TBD
e-mail: dmc345@psu.edu
phone:

Internet access to the course:

The course syllabus, the class lecture notes, copies of exams, problem sets and solutions will all be posted on the Web at **ANGEL**

Course Objectives:

- to develop the tools necessary to think about cloud physics and chemistry
- to learn the cloud physics and chemistry and its role in weather and climate

Course Approach:

This course will be a combination of lectures, class discussions, and case studies. Preparation for class will be essential. Please bring a calculator if you are not facile with estimations.

Grading:

problem sets	0%
weekly quizzes	20%
1 st mid-term exam	25%
2 nd mid-term exam	25%
final comprehensive exam	30%

Academic Integrity:

I am required by the university to remind you to be honest and do your own work and that there are penalties for cheating. You may work together on the homework, but work alone on the quizzes and exams.

Familiarize yourself with the College of Earth and Mineral Sciences Statement on Academic Integrity at: <http://www.ems.psu.edu/students/integrity/statement.html>

Course Notes:

I will post the following information on the website: abridged class notes; problem sets; solutions to problem sets; study guides; and solutions to the exams.

Course Outline:

- A. Clouds in the Atmosphere
 - 1. The role of clouds in atmospheric processes
 - 2. General characteristics of clouds
 - 3. A brief review of cloud thermodynamics
- B. Properties of aqueous systems
 - 1. Molecular properties and structures
 - 2. Phase relationships
 - 3. Multi-component systems
- C. Atmospheric chemistry
 - 1. Gas-phase chemical reactions
 - 2. Tropospheric and stratospheric chemistry
- D. Aerosols
 - 1. Sources and types of aerosols
 - 2. General characteristics
 - a. Size, surface area, volume, and mass
 - b. Chemical characteristics
 - c. Optical properties
 - 3. Cloud condensation nuclei
- E. Nucleation
 - 1. Liquid phase
 - 2. Ice phase
- F. Cloud and precipitation formation
 - 1. Development of supersaturation
 - 2. Growth by vapor deposition
 - 3. Growth by collisions
 - 4. Cloud-scale phenomena
- G. Cloud and precipitation chemistry
 - 1. Aqueous-phase Chemistry
 - 2. Acid rain
- H. Atmospheric electricity
 - 1. Principles
 - 2. Cloud electrification

References:

Required texts:

A Short Course in Cloud Physics (3rd Edition), Rogers and Yau, 1989

Additional reading:

References on cloud physics, aerosols, and atmospheric chemistry:

Atmospheric Science: An Introductory Survey, Wallace and Hobbs, (QC861.2.W34), 1977

Fundamentals of Weather and Climate, McIlveen, (QC981.3 M43 1991), 1991.

Introduction to atmospheric chemistry, Daniel Jacob, QC879.6.J33 1999.

Clouds and Storms, Ludlam, (QC921.5.L83), 1980.

Microphysics of Clouds and Precipitation, Pruppacher and Klett, (QC921.5 P78), 1978.

Chemistry of the Upper and Lower Atmosphere, Barbara Finlayson-Pitts, James Pitts, 99-63218, 2000.

Atmospheric Chemistry and Physics, John Seinfeld and Spiros Pandis, QC879.6.S45 1997

General references:

Chemical Kinetics and Photochemical Data for Use in Stratospheric Modeling, Demore et al., JPL Publication 94-26 1994.

U.S. Standard Atmosphere, 1976, NOAA, 1976.

Useful journals:

Aerosol Science; Atmospheric Chemistry; Atmospheric Environment; Environmental Science Technology; Geophysical Research Letters; Journal of Atmospheric Science; Journal of Geophysical Research; Nature; Science

Useful websites:

- JPL rate coefficients, absorption cross sections, and enthalpy data:
http://jpldataeval.jpl.nasa.gov/pdf/JPL_02-25_rev02.pdf
- [Fundamental physical constants and atmospheric properties](#)
- Atmospheric chemistry glossary:
<http://www.shsu.edu/~chemistry/Glossary/glos.html>
- NIST chemical kinetics data base: <http://kinetics.nist.gov/index.php>
- NASA electronic textbook on stratospheric chemistry:
http://see.gsfc.nasa.gov/edu/SEES/strat/class/S_class.htm