

**CHEMISTRY OF ATMOSPHERES**  
**METEO 532**  
**FALL 2005**

**Instructor:** Dr. Anne Thompson, [anne@met.psu.edu](mailto:anne@met.psu.edu)

**Phone:** 814-865-0479

**Room:** 510 Walker Bldg

**Office Hours:** 1400-1500, Wed. 1430-1530, Thurs.

**COURSE CREDIT:**

Grade will be based on

- (1) Homework, Problem Sets (20-25%)
- (2) Two-three Closed-book Exams 55-60%
- (3) Research Project (20%) Total = 100%

Homework, Problem Sets. There will be 4-5 of these. Use all resources to solve problems, eg books, journals, fellow students, instructor.

Exams. Closed-book exams are based on factual material and general concepts covered in class and in assigned reading. I am required to remind you of University Policies on Academic Integrity

Research Project. Purposes of Research Project: (1) gain practice in formulating a research problem, including descriptions of how problems are solved and unresolved issues could be approached; (2) inform and educate a scientifically knowledgeable audience (your fellow students) on a topic that lies outside your own research area.

Project consists of an oral presentation to the Class with an Outline reviewed by the Instructor 2 weeks before the presentation. Oral reports will follow the class lectures (ie in December) and each is scheduled for ~ 30 minutes, including discussion (17 vugraphs maximum!). Order of oral reports is by last 4 digits of your ID. Factors affecting the Project Grade are:

- 1) Approach to problem
- 2) Originality & creativity
- 3) Completeness of understanding and research
- 4) Clarity in communication
- 5) Discrimination of opinion from fact

Topic - YOU choose! I will give pointers or suggest topics, but you will do a better job if you pick something that interests you! Do not shy away from topics that are interdisciplinary, unusual, or controversial. Be as rigorous as possible and defend all contentions and conclusions.

**EXPECTATIONS OF CLASS** - No missed classes. If you must, phone the instructor. Let us know in advance of religious observances, disability accommodation.

## METEO 532 - CHEMISTRY OF ATMOSPHERES SYLLABUS

FALL 2005

Dr. Anne Thompson, Instructor

**Summary:** Fundamental concepts of atmospheric composition with emphasis on chemical constituents. Application of thermodynamics, kinetics, spectroscopy and photochemistry to atmospheric gases and particles. Introduction to atmospheric ozone and biogeochemical cycles of C, H, N and S. Brief introductions to chemistry and climate change, chemistry in clouds and aerosols.

**Text:** J. H. Seinfeld & S. N. Pandis, *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, Wiley-Interscience, 1998. To be covered - Chapters 1-5, Portions of Chapters 6, 19-21. There will be supplementary material from Prof Brune, Stewart (HU) and material from some of the books at the end. Pdfs of class lectures will be posted.

### OUTLINE

#### I. INTRODUCTION

- A. Historical Perspective - Aspects of Chemistry to be Covered
- B. Basic Chemistry & Physics, Units
- C. Atmospheric Stability & Circulation
- D. Electromagnetic Radiation
- E. Biogeochemical Cycles & Atmospheric Budgets

#### II THERMODYNAMICS, KINETICS

- A. Enthalpy - Formation & Combustion
- B. Free Energy - Can a Reaction Go?
- C. Equilibrium
- D. Rates, Rate Constants, Order
- E. Lifetimes, Half-life
- F. Activation Energy, Arrhenius Expressions
- G. Kinetic Theory
- H. Calculations of Rate Constant w/ Collision Theory
- I. Transition State Theory
- J. Steady-state Analysis

#### III. PHOTOCHEMISTRY & SPECTROSCOPY

- A. Absorption Spectra
- B. Term Symbols & Selection Rules
- C. Photolysis
- D. Layers in the Atmosphere

#### IV. STRATOSPHERIC CHEMISTRY - OZONE HOLE

- A. Dynamics of Stratosphere
- B. Chemical Cycles - Nox, Hox, Halogens
- C. Ozone Hole. Models, Assessments, Ozone Hole Predictions

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**V. TROPOSPHERIC CHEMISTRY & CYCLES**

- A. Ozone and the Ox Family
- B. Nox, HOx Families
- C. Methane, CH<sub>4</sub>
- D. CO & Nonmethane Hydrocarbons (NMHC)
- E. The SOx Family

**VI. AQUEOUS PHASE, PARTICLES (INTRO. TO AEROSOLS)**

**VII. CHEMISTRY-CLIMATE CONNECTION**

**STUDENT SEMINARS -**

**LAST 2 CLASSES**

**OTHER TEXTS:**

B. J. Finlayson-Pitts and J. N. Pitts, Jr., *Chemistry of the Upper and Lower Atmosphere*, Academic Press, 1999.

D. J. Jacob, *Introduction to Atmospheric Chemistry*, Princeton University Press, 1999.

P. V. Hobbs, *Introduction to Atmospheric Chemistry*, Cambridge University Press, 2000.

P. Warneck, *Chemistry of the Natural Atmosphere*, 2<sup>nd</sup> ed., Academic, 1998.

R. P. Wayne, 3<sup>rd</sup> ed, *Chemistry of Atmospheres*, 2000.

T. E. Graedel and P. J. Crutzen, *Atmospheric Change*, W. H. Freeman, 1993.

R. P. Turco, *Earth under Siege*, 1997.

A. E. Dessler, *Chemistry and Physics of Stratospheric Ozone*, 2000.

Good for Basics:

J. Wallace & P. V. Hobbs, *Atmospheric Science*, Introduction to Meteorology

P. V. Hobbs, *Basic Physical Chemistry for the Atmospheric Sciences*, Cambridge University Press, 1995;  
2<sup>nd</sup> ed., 2000.