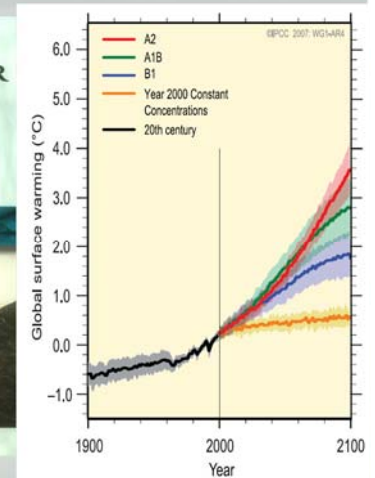
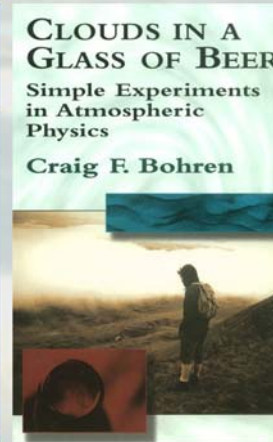
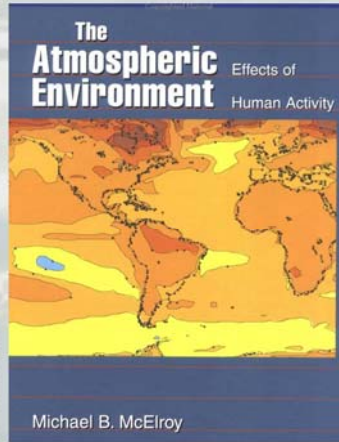
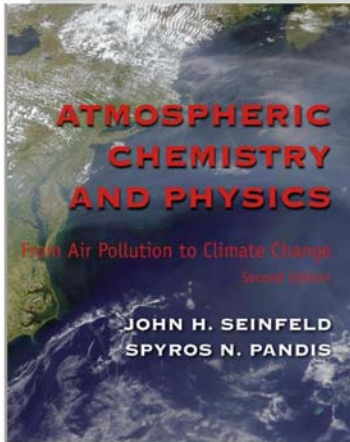


Atmospheric Chemistry and Physics (CBE:5425 / CEE:5115)
Spring 2016 Charles Stanier
Dept. of Chemical and Biochemical Engineering



1. Time and Place of Course

Tues / Thur 2:00 – 3:15 PM. 2057 LIB

2. Instructor

Charles (Charlie) Stanier
Office: 4133 Seamans Center
Phone: 335-1399
Email: cstanier@engineering.uiowa.edu
Office Hours: by appointment

3. Textbooks

Required

- Seinfeld, J.H. and Pandis, S.N. “Atmospheric Chemistry and Physics,” 2nd ed., 2006.

Optional / Supplemental

- Bohren, Craig, Clouds in a Glass of Beer. Dover Publications (July 10, 2001)
- Bohren, Craig. “What Light Through Yonder Window Breaks,” John Wiley and Sons, 1991.
- Jacobson, Mark Z. Fundamentals of Atmospheric Modeling. 2nd Ed. Cambridge Univ Press. 2005.
- Pielke, Roger A. “Mesoscale Meteorological Modeling, 2nd Ed.” Academic Press, 2002.
- Stull, Roland B. “An Introduction to Boundary Layer Meteorology (Paperback)” Springer, 2004.
- Numerical Recipes. Cambridge University Press; 3 edition (September 10, 2007). www.nr.com

4. Target Audience & Prerequisites

- a) The class is aimed at a wide range of student levels – from seniors and beginning graduate students to advance graduate students.
- b) Assignments and projects will be tailored to the student's level. Graduate students will be expected to do more comprehensive and fundamental projects. Undergraduates can use models as “black boxes” without exploring their inner workings. Problem sets may have two levels of questions (grad vs. undergrad) or questions that are optional for undergraduate students but required for graduate students.
- c) A course in reaction kinetics is required as a co-requisite. The ideal course for this is 52:105 Chemical Reaction Engineering or an equivalent course. Contact instructor for permission to waive this co-requisite requirement.
- d) Exposure to environmental chemistry, environmental science, aerosol technology, meteorology, numerical methods, computer programming, and/or environmental engineering is helpful, but not required.

5. Course Goals

- a) By the end of this class, students should be able to take current research in atmospheric chemistry and physics – including field, laboratory, and computational research – and interpret it and place it in scientific context.
- b) By the end of this class, students should be able to develop and interpret the 1-dimensional radiation balance of the earth system.
- c) By the end of this class, students will be able to run and interpret output from selected research grade atmospheric simulations.
- d) By the end of this class, students will be able to answer basic questions regarding global circulation, global biogeochemical cycles, synoptic meteorology, vertical transport of pollutants, sampling techniques for gas phase compounds, aqueous phase reactions, deposition, gas-particle partitioning, photolysis, and atmospheric residence time.
- e) By the end of this class, students will be able to answer detailed questions regarding the HO_x cycle and photochemical smog and ozone formation, including identifying NO_x and VOC limited oxidation regimes. They will also be able to present model simulations regarding ozone, NO_x and VOC orally and graphically.
- f) By the end of this class, students will be answer basic questions regarding aerosol size distributions, dynamics of aerosol particles, dynamics of aerosol populations, radiative transfer involving aerosols, cloud formation, aerosol thermodynamics, and sampling techniques for aerosols.

Time permitting, the additional course goals will be pursued:

- g) By the end of this class, students will have exposure to global climate change, including the issues of radiative balance, carbon cycle, and recent IPCC summary reports.
- h) By the end of this class, students will have exposure to dispersion modeling and chemical transport modeling by Eulerian and Lagrangian methods.

6. Course Outline

Class	Date	Topic	Read Before Class
1	Tue, Jan 19	Atmospheric Structure & Constituents	S&P Chapter 1
2	Thu, Jan 21	NO CLASS - STANIER TRAVEL DAY	
3	Tue, Jan 26	Atmospheric Structure & Constituents	S&P Chapter 2
4	Thu, Jan 28	General Circulation / Horizontal Atmospheric Motion / Synoptic Meteorology	S&P Chapter 21
5	Tue, Feb 02	Global Biogeochemical Cycles	S&P Chapter 22
6	Thu, Feb 04	Worked Examples & Discussion	
7	Tue, Feb 09	Chemical Kinetics of Atmos. Chem.	S&P Chapter 3
8	Thu, Feb 11	Worked Examples & Discussion + Quiz	
9	Tue, Feb 16	Atmospheric Radiation & Photochemistry	S&P Chapter 4
10	Thu, Feb 18	Application of Atmospheric Chemical Kinetics: Stratospheric Chemistry, Chapman Cycle, HO _x Budget	S&P Chapter 5
11	Tue, Feb 23	Application of Atmospheric Chemical Kinetics: Stratospheric Ozone Depletion	
12	Thu, Feb 25	Tropospheric Chemistry I: OH and CO	S&P Chapter 6 (cont below)
13	Tue, Mar 01	Tropospheric Chemistry II: HO _x Cycle	S&P Chapter 6 (cont below)
14	Thu, Mar 03	Tropospheric Chemistry III: Hydrocarbon Oxidation, NO _x and VOC	S&P Chapter 6 (cont below)
15	Tue, Mar 08	Overview of Gas Measurement Techniques	Clemitshaw paper and also "Review of Gas Phase"
16	Thu, Mar 10	flexible day	

Class	Date	Topic	Read Before Class
	SPRING BREAK (Mar 14-18)		
17	Tue, Mar 22	Aqueous Phase Kinetics and Thermodynamics, S(IV) to S(VI), Acid Rain, and Haze	Bohren Chapter 15
18	Thu, Mar 24	Aqueous Phase Kinetics and Thermodynamics, S(IV) to S(VI), Acid Rain, and Haze	S&P Chapter 7 (cont below)
19	Tue, Mar 29	Overview of Atmospheric Aerosols	S&P Chapter 7
20	Thu, Mar 31	Group Project Presentations	Bohren Chapter 16
21	Tue, Apr 05	Atmospheric aerosol cont.	
22	Thu, Apr 07	Aerosol Thermodynamics	Bohren Chapter 18
23	Tue, Apr 12	Aerosol Thermodynamics	
24	Thu, Apr 14	Vertical Stability, Local Scale Meteorology	S&P Chapter 8
25	Tue, Apr 19	3D Atmospheric Modeling	S&P Chapter 9
26	Thu, Apr 21	3D Atmospheric Modeling	S&P Chapter 16
27	Tue, Apr 26	Overview of Aerosol Sampling Techniques	S&P Chapter 25
28	Thu, Apr 28	flexible day	
29	Tue, May 03	Individual Project Presentations	handout
30	Thu, May 05	Individual Project Presentations	

Assignments

Homework assignments (~6 in number)
Group projects (1 in number)
Individual projects / presentations (1 in number)

Note: grading checklists will be provided for group and individual projects. These will be used by the instructor for grading and for peer assessment of oral presentations. Students will be asked to prepare questions for discussion sessions and will be asked to grade their own participation.

7. Quizzes

There may be 1-3 announced class quizzes that will have computations and be 30-60 min in length
There will be 2-4 unannounced quizzes that will be qualitative, be based on the reading, and be 5-10 min in length.

9. Exams

One final exam.

NOTE ON EXAMS: Regrading of quizzes and exams will only be done if the exam was in ink. Quizzes and exams completed in pencil will not be rescored.

10. Grading

Portions of the class will be weighted using the following percentages

Problem Sets:	30%
Group Project	17.5%
Quizzes:	12.5%
Individual Project:	20%
Participation/attendance:	7.5%
Take home exam:	12.5%

Expectations:

A

- Completion of all or nearly all homework with attention to detail and honest effort
- “Pulling one’s weight” on group project with evidence of good teamwork; completion of group project with attention to detail, honest effort, neat & logical writeup, and plausible physical results
- Meeting of all milestone dates in the individual project; completion of individual project with attention to detail, honest effort, neat & logical writeup, and plausible physical results
- Demonstration in quizzes and take home exam that a majority of the material has been comprehended, that most of the basic computations and problem solving techniques discussed in the class can be done by the student, that all readings have been done, that appropriate units and physical plausibility of answers is discussed.
- High quality presentations and supporting analysis/calculations for projects OR significant improvement in presentations throughout semester. Specifically – want to see good slides, understanding of chemical and physical fundamentals, good delivery, and interest in subject material
- 100% attendance unless discussed prior to class with instructor
- Active participation in class

B

- Severe deficiency in one area above
- Major deficiency in two areas above
- Minor deficiency in three or more areas above

C

- Severe deficiency in two or more areas above
- Major deficiency in three or more areas above
- Major deficiency in two areas above, and minor deficiency in more than two additional areas

11. Guidelines on Academic Misconduct and Other Matters

- Cheating on hour or final exams will result in an F in the course. Examples of cheating include but are not limited to looking at your neighbor's exam papers, discussing problems during an exam, or copying answers from another exam paper. For a take home exam, communicating (verbally, nonverbally, or electronically) about what websites or textbooks may have useful information is also considered cheating.
- In this course, academic misconduct on the final individual project will result in an F for the course.
- Cheating on a quiz will result in a zero for the quiz portion of the class (e.g. a zero for all quizzes in the class). Examples of cheating include but are not limited to looking at your neighbor's quiz papers, discussing problems during a quiz, or copying answers from another exam paper.
- Plagiarism on a lab report or project may result in penalties up to 0 in the quiz portion of the class (e.g. a zero for all lab reports) for all members in the lab group. Lesser penalties may be used at the instructor discretion.
- Acceptable collaboration on homework is defined as working on problems together. However, each student should write out the final calculation for themselves, and calculate any quantities using their own calculator or spreadsheet. This includes the visual basic simulator – while working together to get the basic idea of a VB simulator problem, the final parameter adjustments and graphs should be done individually. Otherwise, the person sitting at the computer may learn the most.
- Acceptable collaboration when using computer tools is similar. It is extremely useful to sit at neighboring computers and to talk to one another about lines of code, syntax, errors, and results, each student should create, run, edit, and comment their own code on their own college computing account. Working on a matlab program “together” (with one person typing and another looking over their shoulder) and then turning in two copies of the same program is not acceptable because the learning and preparation for quizzes and exams is not equal.

12. Policy statements:

12a. Disabilities:

Accommodations for Disabilities. If you feel that you may need an accommodation based on the impact of a disability please contact Prof. Charles Stanier privately to discuss your specific needs. You may also contact the Office of Student Disability Services (319/335-1462) to discuss the accommodations that are available for students with documented disabilities.

12b. Determining which college's rules and regulations apply

This course is given by the College of Engineering but may be taken by students enrolled in colleges such as the Graduate College and the College of Public Health. The following document describes the applicability of policies from Engineering versus those from other colleges. Details of the University policy of cross enrollments may be found at: <http://www.uiowa.edu/~provost/deos/crossenroll.doc>.

12c. Attendance and federal financial aid.

Short version. Non-attendance of class, especially in the first 10 days, can lead to requirements for prompt repayment of federal financial aid.

Long version, from the office of the Provost:

Federal financial aid regulations require that The University of Iowa take additional steps during the semester to verify that students receiving federal financial aid are active in their courses. We want to stress that The University of Iowa does not have an attendance policy and we do not anticipate creating an attendance policy. However, to keep our students eligible to receive federal Title IV financial aid, the University must comply with the new regulations. We need your help to do so. Specifically, we are asking that all faculty and instructors respond to requests from the UI Registrar and UI Office of Student Financial Aid for specific information about the academic activity of their students.

The UI Office of Student Financial Aid may be able to reduce the financial liability of individual students by thousands of dollars based on your verification of academic activity (as defined below). During the Spring 2011 review, students for whom academic activity could not be verified were required to repay an average of \$4700 in federal financial aid. For many students, this debt may be insurmountable and put an end to their academic careers. Your assistance is extremely important.

Each semester and for each class, the UI Registrar asks faculty and instructors to verify after the tenth day of the semester that a student attended class or participated in an academic activity (as defined by the U.S. Department of Education) on any day since the beginning of the class. The University REQUIRES 100% completion of the tenth day attendance report by faculty and instructors in order to comply with federal financial aid regulations. The UI Registrar also asks faculty and instructors to verify academic activity at midterm each semester. We request that all faculty and instructors complete these verification forms for every class.

If a student receiving federal financial aid receives ALL grades of I, F, U or N, during any semester, the UI Office of Student Financial Aid may contact you after the end of the semester to obtain a last date of academic activity. This date will determine whether or not a student has to repay a portion of his or her federal financial aid (grants and loans). The UI Office of Student Financial Aid is required by federal law to complete this review and adjust financial aid within 30 days of the end of the semester. We request that all faculty and instructors watch for an email of this nature and respond by the deadline provided in the email.