ATMOSPHERIC CHEMISTRY

CHEM F606 (cross listed as ATM F606) Overview and Schedule ---- Spring 2017

Instructor	Dr. Jingqiu Mao (Reichardt 188, Akasofu 318, 474-7118, jmao2@alaska.edu)
Office Hours	Tu, Th 11:20A-13:00P and any other time by appointment
Class	Tu, Th, 9:45A-11:15A, REIC 204
Text:	Introduction to Atmospheric Chemistry, Daniel J. Jacob
	(Available online: http://acmg.seas.harvard.edu/people/faculty/djj/book/index.html)
Supplements	Atmospheric Chemistry and Physics: from Air Pollution to Climate Change, John H. Seinfeld and Spyros N. Pandis, 3rd Edition.

<u>Course Description (from catalog):</u>

Chemistry of the lower atmosphere (troposphere and stratosphere) including photochemistry, kinetics, thermodynamics, box modeling, biogeochemical cycles and measurement techniques for atmospheric pollutants; study of important impacts to the atmosphere which result from anthropogenic emissions of pollutants, including acid rain, the "greenhouse" effect, urban smog and stratospheric ozone depletion. Special fees apply. Prerequisites/Co-requisite: ATM F601 or permission of instructor. (Cross-listed with ATM F606. Stacked with CHEM F406.) (3+0)

<u>Course objectives / Learning Goals:</u>

By the end of the semester, you will have a basic knowledge of:

- The atmospheric chemical composition
- The transformations of these compounds
- The importance of chemicals in the atmosphere for climate, human health, and ecosystem health
- Air pollution and atmospheric removal of pollutants

You will be able to understand the conversations of atmospheric chemists, seminars on atmospheric chemistry, and discussions with fellow students studying atmospheric chemistry. You will also develop skills in higher-order analysis that will assist both in chemistry pursuits and general studies.

<u>Prerequisites:</u>

Because students may come to this class with a variety of backgrounds, I have made accommodations for students who are either from a pure atmospheric or a pure chemistry background. In either case, I will provide tutorials on the topic that you are missing. A fully prepared student will have the following:

- Interest in understanding the atmosphere's chemical composition and transformations
- Basic atmospheric structure (Atmospheric layers, vertical profiles of pressure and temperature) (A)
- Basic Chemistry (periodic table, simple compound naming) (B)

If you feel you have a lack in either (A: Atmospheric structure) or (B: Basic chemical principles), you should attend the tutorial sessions. These sessions will be held during the first three weeks of classes at a time that is convenient for interested students. In addition to these basic topics, we will cover the following topics, but some knowledge in this area would be beneficial:

Chemical equilibrium, Chemical kinetics, Oxidation states, Chemical catalysis, Basic photochemistry

Course Structure

Classroom sessions, held twice a week, discuss theoretical and practical aspects of atmospheric chemistry. The class-time lectures and discussions will follow the course's textbook. Problem sets are assigned every two weeks. The solutions to problem sets are due at the beginning of class on Tuesday. Please begin the problem set early so that you do not have a deadline crunch and are able to ask questions regarding the problems.

Another part of the class is to do a term project using a computer model to explore chemical transformation of atmospheric pollutants. After an introduction period of lectures on the basic concepts, we will meet one-on-one to discuss the design of your project. All students will participate the term project. Each graduate student will have their own project and will give an oral presentation on their project at the end of the semester. The presentation and subsequent discussion will take approximately 20 minutes. In preparation for your presentation, you are required to discuss your presentation one-on-one with the instructor. This discussion will probably take a half hour to an hour, and you are responsible for making an appointment with the instructor.

Working in groups:

While working on your solutions to problems, you may work in groups. In fact, working in groups usually results in faster and deeper learning. Whether you work in a group or alone, you MUST write up your own solution to the problem. This provision includes computational work; you must write up your own spreadsheet to solve a numerical problem. Copying the solution of another student is not working in a group and will lead to a hole in your understanding that will appear in your exam performance. My advice is to work in groups but don't cheat yourself.

Grading:

This course is graded with letter grades but no +/- grades. This class is a stacked course, meaning that both senior-level undergraduates and graduate students can take the course. Graduate students taking the course are graded by the following scheme:

Midterm exam	20%
Final exam	20%
Problem sets	40%
Project/presentation and in-class discussion	20%

Students taking CHEM/ATM F606 complete a few extra problems on the problem compared to the undergraduate students. Graduate-level students also lead a term project and give in-class presentation, which is a graded activity, and all students are given credit for participation in the in-class discussions of oral presentations.

Homework problem sets are due on Tuesdays at the beginning of class. I will give you 5 free late days. You may use these days whenever you want without penalty. If you exhaust these 5 free days, each additional late day is penalized 10% of your grade on that late problem set. If you have to travel for a conference or have another emergency, I will make every reasonable attempt to accommodate these issues as long as you either inform me before a planned absence or immediately after an emergency.

Tentative Grade Scale:

A	90 - 100%
B	80 - 89%
C	70 - 79%
D	60 - 69%

If I find that students are close to a borderline between grades, I may chose to lower the threshold for the higher grade, but I will not raise the thresholds above the scale listed above.

Students with documented disabilities:

Students with documented disabilities who may need reasonable academic accommodations should discuss these with the professor during the first two weeks of class. You will need to provide documentation of your disability to Disability Services in the Center for Health and Counseling, 474-7043, TTY 474-7045

Tentative Schedule:

Wk	Dates	Topic	Reading
1	17,19 Jan	Introduction/ Atmospheric chemical composition	1,2
2	24,26 Jan	Simple atmospheric models; lifetimes	3
3	31 Jan, 2 Fe	Atmospheric Transport and geochemical cycling	4.2,4.3
4	7,9 Feb	Oxidation states of elements and geochemical cycles	6
5	14,16 Feb	Aerosol particles / Radiative forcing	7
6	21,23 Feb	Aerosol particles	8
7	28Feb,2 Ma	Kinetics & Equilibrium & **Midterm Exam**	9.1-9.2
8	7,9 Mar	Photochemistry / Stratospheric ozone	9.3, 10.1
9	13-17 Mar	**Spring Break – no classes**	----
10	21, 23 Mar	Stratospheric ozone	10.2-10.3
11	28, 30 Mar	Aqueous / heterogeneous reactions	10.4
12	4, 6 Apr	Tropospheric oxidation	11
13	11,13 Apr	Ozone Air pollution	12
14	18,20 Apr	Acid deposition and aerosol production	13
15	25,27 Apr	Arctic atmospheric chemistry / in-class presentations	
16		**Final Exam**	

Important dates:
27 Jan 2017 (Fr) Last day to drop class (without W on transcript)
30 Jan 2017 (Mo) Last day for 100% refund of fees and tuition
2 Mar 2017 (Th) Midterm exam (in class)
13-17 Mar 2017 (Mo – Fr) Spring Break
31 Mar 2017 (Fr) Last day to withdraw from class (with W on transcript)
1 May 2017 (Mo) End of Instruction (overall UAF)
4 May 2017 (Th) 8:00-10:00 AM **EARLY!** Final Exam