ATS 581A2
Syllabus – Fall 2019

ATS 581A2 | Chemical Kinetics and Photochemistry of the Atmosphere

Fundamentals of gas phase kinetics, photochemistry, and (if time permits) heterogeneous and multiphase chemistry for atmospheric chemist.

Instructor: A.R. (Ravi) Ravishankara
Offices: ATS West 212 and Chemistry C201
Office Phone: 970-491-2876
Email: A.R.Ravishankara@colostate.edu

Office Hours: By appointment on Monday through Wednesday only.

Time and Location: Monday and Wednesday, 1:00 PM to 3:15 PM with 10-minute break
Six weeks: August 26 through October 2, 2019
ACRC 212B

Textbook: There is no specific book at this time for the course.

Additional References: Will be assigned as needed.

Course Objective: Students will gain an understanding of the fundamentals of gas phase and heterogeneous/multiphase kinetics, and of photochemistry. In particular, we will emphasize not only "what and how" of thermodynamics but also "why." The students should gain a working knowledge of kinetics and photochemical information needed to understand atmospheric chemistry and to carryout research in atmospheric chemistry.

Let us make this an enjoyable learning experience!

Tentative Learning Objectives:
(Dates for specific topics will be decided based on what you all know already. I may have to fine tune the material depending on your level of preparation for this class.)

Week 1: Structure and composition of the atmosphere as it relates to chemical processes. Basic gas phase kinetics. Order, molecularity, rate equations, bimolecular reactions, and theories of bimolecular reactions (needed to understand kinetics). Positive and negative activation energies. Network of reactions.
Week 2: Connections between thermodynamics and kinetics. First order and third order reactions. Pressure dependence of reactions. Fall off curves. How to fit them and use them. How rate coefficients are measured.
Week 3: Basics of atmospheric photolysis rate coefficient and their calculations. TUV and Fast Jx calculations. Absorption cross sections, quantum yields, and how one gets these parameters.
Week 4: Chemical reaction mechanisms. Their uses and abuses. Steady state approximation. Lifetimes, turnover times, etc. Use of various kinetics and photochemistry evaluations. Uncertainty analyses and how to interpret uncertainties in data evaluations.

Week 5: Heterogeneous and multiphase reactions. Uptake coefficient. Representations in terms of fundamental parameters. Use of the derived uptake coefficients in models and mechanisms.
Week 6: Integration of previous concepts and for application to tropospheric and stratospheric chemistries.

Final exam: October 2, 2019 (90 mins) 1:00 PM to 2:30 PM.

Grading: The grade for this 2-credit course will be decided by **homework (60%), in-class participation (10%) and one final exam (30%)**. *It is absolutely essential that you take homework seriously! Your grade depends on it!* The final exam will be in class on October 2nd. Unexcused absence from the exam will result in a zero for the exam grade and will lead to a fail grade. You must clear absence in the final exam with me at least a week before the exam. I will not grade on a curve, so there will be cut points based on the expected levels of understanding the material.

Homework: Homework assignments will be due in class on the due date (i.e., turned in before lecture starts). Late homework assignments will lose 20% if turned in after the week of the due date. Please contact me if there are extenuating circumstances. Those received late will not be graded and will receive a score of zero. There will likely be 4 or 5 homework problem sets, each with its own set of scores (i.e., they are all not equal). Each student has to turn in their own problem set. However, consultations with other students is acceptable and encouraged. The work must be that of the student. (You will not learn if you don't do the work! As said earlier, *your grades depend on your homework*.)
It is imperative that you write out your homework very clearly, in a size that is easy read, and in a logical fashion. If I can't read it (my eyesight is not great!), you don't get credit, especially partial credits! Show enough work so that I can follow what you are doing. Derivations MUST be clearly written out. Please staple the pages together. If your handwriting is not good, please type it out. I don't want to receive homework that looks like a dog chewed on it or has gone through a washing machine!

Expectation: I expect all of you to look through your undergraduate chemistry and physics books as background for what is covered here. *This course, which is short, is meant to be a starter- not the end!*
All students are expected to show up prepared to actively participate in class discussions. Absence from class has to be discussed with me ahead of the class (unless it is an emergency). More than two unexcused absences will disqualify you from taking the final exam. Problem sets should be turned in by the due dates (see strict late assignment policy). It is expected that the students will devote 6 hours or more per week in homework etc. *Some of the material can appear to be deceptively simple-*

you think that you understand it until you are faced with a problem! I learned this lesson the hard way!

Academic Integrity: While I encourage you to discuss your understanding of course material with others, particularly for homework problems, any material that you submit MUST represent your own independent work and comprehension. The course will adhere to the Academic Integrity Policy of the Colorado State University General Catalog and the Student Conduct Code.

Accommodations: People with diverse learning styles and/or needs are welcome in this course. Please talk to me if you have a disability or health consideration that requires accommodations. Let us work together to make you succeed.

In class behavior: Use of mobile phones in the class for calls or text messaging is **prohibited**. If it is urgent, you must leave the classroom to take the call or respond to the text message. Use of laptops or tablets for note taking is discouraged in this class. If you choose to use them, please sit in the last row so that it does not distract the other students.

Course regulations: University regulations regarding dropping, incomplete, etc. will be strictly adhered to. If you have any special cases, talk to me as soon as possible.

Logistics: I will try my best to use CANVAS for the class. I will post my lecture notes on CANVAS within a day or two of the lectures. Additional logistical information will be given in the class as necessary.
To help me familiarize, please post your photo on CANVAS.

Any other issues: Please come talk to me if there are issues that are not covered in this material.

A special note: Come prepared to work hard and learn! This is a compressed, intensive course. A lot of material will be covered in 6 weeks.