ATMOSPHERIC CHEMICAL MECHANISMS [CHEM 629]

Fall 2019

Department of Chemistry
University of Wisconsin, Madison

Instructor: Associate Professor Timothy H. Bertram
E-mail: timothy.bertram@ wisc.edu
Phone: 608.890.3422
Location of Instructor Office Hours: Chemistry 4355
Instructor Office Hours: Directly following lecture or by appointment
Course Website: https://canvas.wisc.edu/courses/171654

Lecture: 9:55-10:45AM MWF; Room 2311

Credits: 3, based on the traditional Carnegie definition. Chem 629 has three 50-minute lectures per week. Outside classroom work includes background reading and problem sets which is expected to amount to approximately 6 hours per week on average.

Course Designation: Breadth – Physical Sci. counts toward the Natural Sci. requirement. Level – Advanced. L&S Credit – Counts as Liberal Arts and Science credit in L&S.

Instructional mode: face-to-face

COURSE INFORMATION

Course Description: CHEM 629 is an advanced atmospheric chemistry course that focuses on the chemical mechanisms and kinetics of reactive gases and aerosol in Earth's atmosphere. Fundamental concepts from analytical, physical, and organic chemistry will be used as tools to describe atmospheric processes occurring in both the troposphere and the stratosphere. Specific topics include: Evolution and chemical composition of Earth's atmosphere; applications of the steady-state approximation; residence and renewal time; sources, transformation, transport and deposition of trace gases in the troposphere; air pollution control strategies; stratospheric chemistry.

Course Requisites: CBE 310 or concurrent enrollment in CHEM 561 or 565 or graduate/professional standing.

Learning Outcomes: CHEM 629 has two primary learning objectives for undergraduates and graduate students enrolled in the course: 1) Develop a deep chemical intuition for atmospheric chemical mechanisms and processes operating over wide ranges of time and length scales and 2) Construct photochemical box models of atmospheric processes (e.g., smog formation) to determine the response of criteria air pollutants to changes in atmospheric emissions. CHEM 629 has one additional learning outcome for graduate students: Articulate and synthesize complex chemical knowledge and understanding in both written and oral formats.

Lecture: There are three 50-minute lecture sessions each week covering the theory and applications of various topics in atmospheric chemistry. During lectures I will introduce principles and illustrate concepts with example questions. Lectures will provide an opportunity for discussion as well as tackling problems in a group. As a result, participation is central in class.

Problem Sets: Problem solving is a crucial aspect of this course and problems will be assigned on a regular basis (ca. 6-8 over the course of the semester). Assignments will be made available at least 7 days before they are due. Graduate problem sets will often include 1-2 additional computer-based problems.

Exams: There will be two in-class exams of 50 minutes each. There will not be a written formal final exam. No makeup exams will be given. Please be alert to these exam dates. Please report any religious conflicts with exams or laboratory exercises to your teaching assistant by the end of week two.

	Date and Time	Topics Covered
In Class Exam #1	10/04/2019 (F)	Stratospheric Chemistry
In Class Exam #2	11/01/2019 (F)	Tropospheric Chemistry

Final Projects: The final project will be comprised of a written paper and oral presentation. Undergraduate final projects will focus on a critical review of an analytical technique used in atmospheric chemistry. Graduate final projects will focus on the development of a novel proposal that builds on the concepts and computer modeling learning in this class.

Grades: Your final grade will be computed with the following scheme:

	Percent	Notes
In Class Exams (2x, 15% each)	30%	No make-up exams
Problem Sets	40%	Not all P.S. are equally weighted
Final Project and Report	30%	See details above

Letter grades will be assigned using the following conversion between numerical scores and letter grades: 90-100 (A), 8589 (AB), 80-84 (B), 75-79 (BC), 70-74 (C), 65-69 (D), below 65 (F).

Your scores are available to you on Canvas, with a 3-5 day time delay. There are no opportunities for extra credit and late problem sets will be accepted for two days after the due date, with a 10% penalty per day late.

RESOURCES and MATERIALS

- *Introduction to Atmospheric Chemistry*, Daniel Jacob. This book is available online at Daniel Jacob's educational website at Harvard University: http://acmg.seas.harvard.edu/people/faculty/djj/book/index.html
- *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, John Seinfeld and Spyros Pandis.
- Chemistry of the Upper and Lower Atmosphere: Theory, Experiments, and Applications, Barbara Finlayson-Pitts and James Pitts.
- Numerous problem sets will require the use of mathematically modelling software. Mathworks MatLab is recommended for this. MatLab is available at no charge to students at UW Madison through a site license. Installation instructions for MatLab can be found at the campus software library: https://www.doit.wisc.edu/services/software/

If you have any questions or concerned regarding access to MatLab for your personal computer or to university computer labs that have MatLab installed, please contact us. It is important that you find a reliable mechanism for using MatLab early in the class.

RULES, RIGHTS & RESPONSIBILITIES

See the Guide's to Rules, Rights and Responsibilities

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA." http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu/

LECTURE OUTLINE

Course Outline and Calendar (based on Fall 2017 CHEM 630):

Week	Start Date	Topic
1	W 9/04	Introductions and Atmospheric Structure
Read: Chapter 1 Jacob		
2	M 9/09	Atmospheric Structure and Chemical Kinetics
Read: Chapter 2 and 3 Jacob		
3	M 9/16	Stratospheric Chemistry
Read: Chapter 10 (10.1 – 10.2) Jacob		
4	M 9/23	Stratospheric Chemistry
Read: Chapter 10 (10.3 – 10.4) Jacob		
5	M 9/30	Stratospheric Chemistry (Exam 1 on 10/04)
6	M 10/07	Atmospheric Instrumentation
Read: Brown et al., Wennberg et al., and Lee et al. papers		
7	M 10/14	Tropospheric Chemistry
Read: Chapter 11 Jacob		

8	M 10/21	Tropospheric Chemistry
Read: Chapter 12 Jacob		
9	M 10/28	Tropospheric Chemistry (Exam 2 on 11/01)
10	M 11/04	Aerosol Particles
Read: Chapter 13 Jacob		
11	M 11/11	Aerosol Particles
Read: Chapter 9 Finlayson-Pitts		
12	M 11/18	Aerosol Particles, Presentations
13	M 11/25	Presentations, no class on 11/27 or 11/29
14	M 12/02	Presentations
15	M 12/09	Presentations