Atmospheric Chemistry and Climate: AOSC & CHEM 433 / AOSC & CHEM 633

Instructor:
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Spring 2022: Tues – Thurs 2:00 to 3:15 pm, Atlantic 2428

Websites: http://www.atmos.umd.edu/~rjs/class/spr2022 & https://umd.instructure.com/courses/1317772

Required Text:

Chemistry in Context: Applying Chemistry to Society **7th Edition** American Chemical Society
(You can either rent a used copy from me for $20, refundable upon return of the book, or use a password protected PDF file I'll provide to all registered students)

Supplemental Text (selected readings will be provided):

Paris Climate Agreement: Beacon of Hope by Ross J. Salawitch *et al*. (available for free via open access)
Twenty Questions & Answers About the Ozone Layer by Ross J. Salawitch *et al*. (also freely available)
Global Warming: The Complete Briefing **5th Edition** by John Houghton (selected readings will be provided)
Green Chemistry: An Inclusive Approach, edited by Béla Török and Timothy Dransfield (ditto)
Beyond Oil and Gas: The Methanol Economy by George A. Olah *et al*. (readings will also be provided)

Course Description. The effects of human activity on atmospheric composition, focused on global warming, the carbon cycle, air pollution, and the ozone layer. Fundamentals of atmospheric chemistry (spectroscopy, kinetics, isotopic analysis, and biogeochemical cycles) are related to the modern understanding of climate change, air quality, and ozone depletion, based on resources such as satellite missions, field campaigns, and scientific assessments published by international agencies. We also examine how society's future energy needs could be met in a more environmentally friendly manner than the present heavy reliance on combustion of fossil fuels. The course is taught at a level appropriate for upper class undergraduate chemistry or physical science majors, as well as all graduate students in a physical science program.

Prerequisites: (CHEM 131 or CHEM135 or CHEM146) and (MATH241); or permission of instructor.

Grades: Grades will be determined based on daily short questions (termed *admission tickets*) due prior to the start of lecture that are based on the readings (30%), problem sets (30%), two in class exams (13.33% each), a final exam (13.34%). In addition, students enrolled in 633 will be required to write a research paper on a topic of their choosing, give a presentation on this paper, and may be assigned an extra question on problem sets. For computation of final course grade, the graduate student paper/presentation will have equal weight as each exam.

Course Topics

- How to Build a Habitable Planet: Geological Evolution of Earth's Atmosphere
- Overview of Global Warming, Air Quality, and Ozone Depletion
- The Greenhouse Effect: Radiative Transfer; Cloud and Water Vapor Feedbacks
- Climates of the Past
- Modeling of Earth's Climate
- The Global Carbon Cycle
- Biogeochemical Cycles of Methane and Nitrous Oxide
- Pollution of Earth's Troposphere: Air Quality, Acid Rain, and Aerosols
- Pollution of Earth's Stratosphere: Ozone Depletion and Ozone Recovery
- World Energy Needs and Future Fossil Fuel Reserves
- The Kyoto Protocol and the Science of CO_2 Stabilization
- Renewable Energy I: Solar, Geothermal, Hydro, and Wind
- Renewable Energy II: Ethanol, Methanol, and Biofuels
- Hydraulic Fracturing aka Fracking
- Nuclear Energy and The Hydrogen Economy
- Geo-engineering of Climate