

E451: Air Pollution and Control

Fall 2016

Professor: Philip Stevens

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Office Hours: TR 11:00 - 12:00 PM, or by appointment

Class Meetings: TR 1:00-2:15 PM PV 272

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The topic of *air pollution* is extremely broad. Issues which fall under the category of air pollution have traditionally included photochemical smog, acid rain and fog, and airborne toxic chemicals. As the field of atmospheric chemistry has grown in response to these issues, it has become clear that the atmospheric processes that control issues of air pollution are tightly linked to each other and to the natural chemistry of the atmosphere. It is also becoming clear that anthropogenic influences on the local scale are influencing the state of the atmosphere on the global scale. As a result, recent national and international policies have addressed the global problems of stratospheric ozone depletion and global climate change, adding these issues to the topic of air pollution.

The formulation of effective policy addressing the issues of air pollution requires an in-depth knowledge of the chemistry and physics behind these issues. The goal of this course is to provide an introduction to the fundamental chemical and physical processes that control the composition and properties of the atmosphere. Topics that we will cover include the chemistry of the natural atmosphere, the polluted atmosphere, photochemical smog, acid precipitation, stratospheric ozone chemistry, polar ozone chemistry and global warming. We will also discuss issues of atmospheric transport, pollutant dispersion, and aerosols.

Course Objectives

- 1) Understand the chemical reactions leading to the formation of photochemical smog, and how this chemistry leads to current control strategies and environmental policy
- 2) Understand the chemical reactions leading to the formation of acid deposition, and how this chemistry leads to current control strategies and environmental policy
- 3) Understand the chemical reactions leading to the stratospheric ozone depletion and the formation of the ozone hole, and how this chemistry leads to current control strategies and environmental policy
- 4) Understand the basic science behind the atmospheric greenhouse effect and how changes in the composition of the atmosphere impacts global surface temperatures

Recommended Prerequisites

One semester of college-level chemistry (C101 or above)

Math M118 or M119 or equivalent

E272: Introduction to Environmental Sciences

Resources

Course Packet: Available on Canvas

Jacobson, *Air Pollution and Global Warming: History, Science, and Solutions* (Second Ed. 2012)

Most of the material for this course will be presented during class lectures. Some of the material presented in class will be placed on Canvas. However, to fully understand the material, ***attendance to lectures is critical***. Experience has shown that success in this course is ***strongly correlated with regular attendance!***

Course Requirements

Problem sets (25%). These *quantitative* problems will emphasize the important material covered in the class. They will be due approximately once every two weeks. *The format for exams will be very similar to the problem sets.*

Two Term Exams (50%). Tentatively scheduled for ***September 29th and November 3^d***

Final Exam (25%). Scheduled for ***Thursday, December 15th, 12:30-2:30 PM***

Grading policy

As adults, it is up to you to attend class and complete the required assignments on time. Experience has shown that students who do not attend lectures regularly and do not complete all the homework assignments in a timely fashion do not do well in this course. The choice is yours.

Academic and personal misconduct by students in this class are defined and dealt with according to the procedures in the Code of Student Rights, Responsibilities, and Conduct, <http://www.iu.edu/~code/code/index.shtml>

Sexual Harassment

As your instructor, one of my responsibilities is to help create a safe learning environment on our campus. Title IX and our own Sexual Misconduct policy prohibit sexual misconduct. If you have experienced sexual misconduct, or know someone who has, the University can help.

If you are seeking help and would like to speak to someone confidentially, you can make an appointment with:

The Sexual Assault Crisis Service (SACS) at 812-855-8900
Counseling and Psychological Services (CAPS) at 812-855-5711
Confidential Victim Advocates (CVA) at 812-856-2469
IU Health Center at 812-855-4011.

More information about available resources can be found here:

<http://stopsexualviolence.iu.edu/help/index.html>.

It is also important that you know that federal regulations and University policy require me to promptly convey any information about potential sexual misconduct known to me to our campus' Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, they will work with a small number of others on campus to ensure that appropriate measures are taken and resources are made available to the student who may have been harmed. Protecting a student's privacy is of utmost concern, and all involved will only share information with those that need to know to ensure the University can respond and assist.

I encourage you to visit <http://stopsexualviolence.iu.edu> to learn more.

Syllabus (Topics scheduled roughly by week)

Introduction

Atmospheric composition and structure

Jacobson, Chapter 3

Basic Tools - Introduction to chemical reactivity

Jacobson, Chapter 1

Topic: Photochemical Smog

Sources and effects

Jacobson, Chapter 4, 8

The chemistry of ozone formation

Exam #1 Thursday, September 29th

Topic: Air pollution meteorology

Models for Risk Assessment

Jacobson, Chapter 6

The Gaussian Plume Equation

Topic: Acid Deposition

Absorption of gases into liquids

Jacobson, Chapter 5, 10

Aqueous pollution chemistry

Exam #2 Thursday, November 3rd

Topic: Stratospheric ozone depletion / the Ozone Hole

The chemistry of the mid-latitude stratosphere

Jacobson, Chapter 11

Polar ozone chemistry

The atmospheric greenhouse effect

Jacobson, Chapter 12

Final Exam: 12:30-2:30 p.m., Thursday, December 15th