SYLLABUS

ENVR 675: Air Pollution Chemistry and Physics
Fall 2016

Class meets: Mondays & Wednesdays 2:30-3:45, McGavran-Greenberg 1303
Instructor: Jason West
Office: 146B Rosenau
Email: jasonwest@unc.edu
Office Hours: After class Mondays & Wednesdays, 3:45-4:30

Course Description and Goals

Air pollution has significant effects on human health and the environment, through interrelated problems of ozone and particulate matter air pollution, acid rain, visibility degradation, mercury, stratospheric ozone depletion, and climate change. Significant strides have been made in the past few decades to improve our understanding of the sources, chemical transformation, transport, deposition, and impacts of different pollutants. We now understand that many air pollutants are linked together through complex chemical interdependencies.

This course is designed for first year graduate students planning to do research on the fate and transport of air pollutants, intending to cover the basics that all such students should know – whether they are experimentalists or modelers, and regardless of their educational background. Other students can also benefit from this course, including students researching air pollution health effects and environmental modeling.

Students will be expected to show mastery of relevant concepts drawn mainly from the Earth sciences, chemistry, physics, and engineering. By the end of this course, students will be able to:

- Explain current air pollution research in the context of the history of air pollution science.
- Explain the relationships between emissions of different air pollutants from different sources, their atmospheric concentrations, and the impacts that they ultimately cause.
- Explain the factors that influence the transport of pollutants around the world.
- Explain the chemical processes that govern the formation and destruction or removal of air pollutants, principally ozone and particulate matter.
- Understand basic laboratory and field techniques in the measurement of air pollutants.
- Participate in smog chamber analyses of chemical transformations of pollutants.
- Apply quantitative analyses related to air pollution through homework problems and on tests.
- Read and understand recent scientific findings from journal articles.

In completing this course, students will improve their fundamental knowledge of air pollution, and will also learn skills in analyzing chemical processes, quantitative scientific methods, and modeling.
Prerequisites

This is a graduate level course. Advanced undergraduates will be admitted to the course with permission of the instructor. Students must have:
- had at least one undergraduate course in chemistry.
- had at least one undergraduate course in physics.
- comfort with math.

Course Requirements and Evaluation

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class participation</td>
<td>10%</td>
</tr>
<tr>
<td>Homework assignments</td>
<td>40%</td>
</tr>
<tr>
<td>In-class quizzes</td>
<td>12%</td>
</tr>
<tr>
<td>In-class exam</td>
<td>13%</td>
</tr>
<tr>
<td>Final exam</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Homeworks are expected to be turned in on time. Late homeworks will lose 10% for each day late, except for exceptional circumstances and the prior approval of the instructor. You are encouraged to work in groups for your homeworks. However, each student is responsible for writing up and turning in their own results for their homework. If you work with others, you are required to include a note on your homework with the names of the people you work with (working with others does not count against you, but you will lose a point if you fail to acknowledge them). Handing in homework identical to another student’s is not acceptable.

Feedback on the Course

You are expected to complete the online evaluation forms for this course (and for all your courses) during the last two weeks of the semester. I also welcome your feedback at any time while the course is in progress. Please arrange to meet with me and discuss, or you may also leave comments anonymously by putting a note in my mailbox.

Readings

There is one required text:


We will also read from the NARSTO PM Assessment (2004), which is available online for free: [http://www.narsto.org/pm_science_assessment](http://www.narsto.org/pm_science_assessment).

In addition, research articles will be handed out in class. Other books are not required to purchase, but are recommended for students planning to focus their research on air pollution:


**Course Schedule (subject to updates)**

Wed., Aug. 24  Introduction to class, Historical view of air pollution problems

Mon., Aug. 29  Atmospheric structure and composition, pressure, Ideal Gas Law, units of atmospheric composition

Wed., Aug. 31  Atmospheric trace constituents: sulfur-containing, nitrogen-containing, and halogen-containing compounds, ozone

Mon., Sept. 5  NO CLASS - Labor Day


Fri. Sept. 9  SPECIAL CLASS Simple models, atmospheric lifetime.

Mon., Sept. 12  Transport of pollutants, global meteorology


Fri., Sept. 16  SPECIAL CLASS Chemical kinetics, atmospheric radiation and photochemistry

Mon., Sept. 19  QUIZ 1

Wed., Sept. 21  Stratospheric ozone chemistry and the Ozone Hole

Mon., Sept. 26  Air pollution measurements (Barb Turpin)

Wed., Sept. 28  NO CLASS

Mon., Oct. 3  Stratospheric ozone chemistry and the Ozone Hole
Wed., Oct. 5  Tropospheric ozone chemistry
Mon., Oct. 10  Tropospheric ozone chemistry, NO\textsubscript{x} and Radical cycles
Wed., Oct. 12  Tropospheric ozone chemistry, role of CO and VOCs
Mon., Oct. 17  Tropospheric ozone, reactions of individual VOCs
Wed. Oct. 19  EXAM
(Fall Break, Oct. 20-23)
Mon., Oct. 24  NO CLASS - CMAS Conference
Wed., Oct. 26  NO CLASS - CMAS Conference
Wed., Nov. 2  The continuity equation and atmospheric modeling, Use of a chemical solver
Mon., Nov. 7  QUIZ 2
  Overview of Particulate Matter
Wed., Nov. 9  Overview of PM
Mon., Nov. 14  Measurements of PM (Barb Turpin)
Wed., Nov. 16  Inorganic PM
Mon., Nov. 21  Inorganic PM
Wed., Nov. 23  NO CLASS – Thanksgiving
Mon., Nov. 28  Inorganic PM, acid rain
Wed., Nov. 30  Visibility, Air pollution health effects
Mon., Dec. 5  Air pollution regulation
Wed., Dec. 7  Air pollution health effects (Ilona Jaspers)

**Fri., Dec. 9  4-7 PM  Final Exam**