

AIR QUALITY ENGINEERING
Civil and Environmental Engineering 218A
Control Number 14179; 3 units
Fall Semester 2002

Instructor:

Prof. William Nazaroff
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office hours: TuF 3:30-5 or by appointment

Lectures:

MWF 2:10-3:00 in 534 Davis

Discussion:

M 4:10-5 in 212 O'Brien (attendance not required); First meeting: 9 September

Prerequisite:

Graduate standing in engineering or physical science, or consent of instructor. In general, senior undergraduate students from engineering or physical science are permitted to take the course provided their overall GPA exceeds 3.0.

Course Description:

Quantitative overview of the characterization and control of air pollution problems. Summary of fundamental chemical and physical processes governing pollutant dynamic behavior. Analysis of key elements of the air pollution system: sources & control techniques, atmospheric transformations, atmospheric transport, deposition and modeling. Air quality management.

Schedule of Lectures, Holidays, Examinations, Absences, and Special Events

- August 26 (Monday) — First lecture (no discussion period)
- August 27 (Tuesday) — WWN off campus; no office hours
- September 2 (Monday) — Academic holiday: Labor Day
- October 2 (Wednesday) — Midterm Exam #1
- October 7-11 — WWN at AAAR conference; no class meetings (to be made up) and no OH
- November 6 (Wednesday) — Midterm Exam #2
- November 11 (Monday) — Holiday: Veteran's Day
- November 28-29 (Thurs-Fri) — Academic holiday: Thanksgiving
- December 6 (Friday) — Final lecture
- December 7 (Saturday) — Class Symposium (approximately 8:00 AM - 3:00 PM)
- December 18 (Wednesday) — Final Exam (5-8 PM)

Text:

- *CE 218A Lecture Notes.* This volume is the primary reference for the course. It is available at Copy Central on Hearst Ave.

Other Sources (available on the reserve shelf of the Kresge Engineering Library):

- *Air Pollution Control Engineering*, N. De Nevers, McGraw Hill, New York, 1995. This book addresses air pollution control from a chemical engineering perspective. It emphasizes emission sources and control technologies, but includes chapters on dispersion modeling, control strategies, pollution effects, and other broader issues.
- *Air Pollution: Its Origin and Control*, 3rd edition. K. Wark, C. F. Warner, and W.T. Davis, Addison-Wesley, Menlo Park, 1998. This book is well written. It attempts to strike a balance between academic rigor and practice, while remaining a text. It largely succeeds. Its level is too elementary for this course.
- *Fundamentals of Air Pollution Engineering*, R. C. Flagan and J.H. Seinfeld, Prentice Hall: Englewood Cliffs, 1988. This volume focuses on combustion as a source of air pollution and on the analysis of control devices. The level is advanced, more like a research monograph than a text in many places.
- *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*. J.H. Seinfeld and S.N. Pandis, Wiley: New York, 1998. A work of high scholarship, this sets the standard for understanding what happens to air pollutants once they are released to the atmosphere. The narrative is readable. The focus is on air pollution science rather than on air quality engineering.
- *Chemistry of the Upper and Lower Atmosphere: Theory, Experiments, and Applications*, B. J. Finlayson-Pitts and J. N. Pitts, Jr. Academic Press: San Diego, 2000. Written from the perspective of a chemist, this is an excellent reference for atmospheric transformation processes & measurement techniques.
- *Aerosol Technology: Properties, Behavior, and Measurement of Airborne Particles*, 2nd edition, Hinds, W. C., Wiley: New York, 1999. The most accessible book on aerosols, its level is about right for this course.
- *Smoke, Dust and Haze: Fundamentals of Aerosol Dynamics*, 2nd edition, Friedlander, S.K., Oxford, 2000. Standard graduate-level monograph on the behavior of airborne particles. Its compact presentation style makes this a challenging book for self study.
- *Aerosol Measurement: Principles, Techniques, and Applications*, P.A. Baron and K. Willeke, eds., 2nd edition, Wiley, New York, 2001. The scope of this book is broader than suggested by the title. It is a good reference on a wide range of issues pertaining to atmospheric aerosols. The writing is scholarly yet accessible.
- *Environmental Engineering Science*, W. W. Nazaroff and L. Alvarez-Cohen, Wiley: New York, 2001. This is a text-in-progress for CE 111. Much of the background or foundation material underlying CE 218A is addressed in this book.

Other resources:

- *CE 218A Problem Solutions*, Two copies of this notebook will be maintained on the reserve shelf of the Engineering Library. My plan is to post solutions to problem assignments and exams in these notebooks on the due date. The likely reality is that they will be there within a few days after the due date.
- Much of the highest quality, state-of-the-art information can be found only in journals. The research literature on air quality engineering is largely published in the following journals. Recent issues of most can be accessed on-line through the California Digital Library (<http://www.cdlib.org/>) or through the UC Berkeley engineering library (<http://www.lib.berkeley.edu/ENGI/ejrnl.html>).
- *Aerosol Science and Technology* (online: 1999-date; physical: ENG TP244.A3 A335)

- *Atmospheric Environment* (online: 1995-date; physical: ENG TD881.A853)
- *Environmental Science & Technology* (online: 1967-date; physical: CHEM TD180.A1 E5)
- *Journal of Aerosol Science* (online: 1995-date; physical ENG QC882.J68)
- *Journal of the Air & Waste Management Association* (online: members only; physical ENG RA576.A1 A5)
- *Web of Science*. This is an amazing resource for doing literature research. It contains a nearly complete catalog of research articles published in archival technical literature for the past half century. Two especially useful features are (1) ability to search for all scholarly works by a given author; and (2) ability to find all subsequent articles that cite any given article. Access this system at www.webofscience.com.
- *Professional Associations*. There are several important professional associations for air quality engineers and scientists in the United States. These offer substantially discounted student membership rates.
 - Air & Waste Management Association: www.awma.org; \$30/y
 - American Association for Aerosol Research: www.aaar.org; \$25/y
 - American Geophysical Union: www.agu.org; \$7/y
 - American Chemical Society: www.acs.org; \$56/y
 - Association of Environmental Engineering and Science Professors: www.aeesp.org; \$15/y
- *Government Agency Websites*. Much important information generated and maintained by governmental agencies is available and well maintained on the web.
 - US EPA: www.epa.gov
 - California Air Resources Board: www.arb.ca.gov
 - Bay Area Air Quality Management District: www.baaqmd.gov

Grading:

Approximately 10 assignments will be issued during the course. These will consist of problems in air quality engineering analysis. In addition, each student is required to participate in the course symposium to be held on Saturday, December 7. Students will alone or in small groups (2-3), to investigate an air-quality engineering issue in depth. At the symposium each student or group will present a 15-minute technical talk to the class. Two in-class midterm examinations plus a final exam will also be held. Here is the weighting scheme for determining the final grade:

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| Midterm examination #1: | 15% |
| Midterm examination #2: | 15% |
| Oral project presentation: | 10% |
| Problem assignments: | 25% |
| Final examination: | 35% |

I last taught this class Fall 2000. Of the 26 students who completed the course, 13 earned A's (1 A+, 5 A-) and 13 earned B's (6 B+, 1 B-). For students who earned an "A," the average score on problem assignments, midterm exams, and the final were 91% 86%, and 84%, respectively. For students who earned a "B," the corresponding respective averages were 85%, 70%, and 66%.

In completing the problem assignments, I recommend that you prepare careful, complete solutions. Doing so is good practice for professional work and will help you gain a deeper understanding of the course material. Fully worked solutions will be posted in the library. I will be happy to discuss the problems with you either in the discussion meeting or during office hours.