CE 109 — INDOOR AIR QUALITY

Civil and Environmental Engineering
Control Number 14066
Spring Semester 2001
3 units

Instructor:
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office hours: M 3:30-5, F 3:30-5:00 (tentative)

Lectures and Discussions:
Lectures: MWF 2-3 in 405 Davis (tentative)
Discussions (as needed): TBA

Prerequisite:
CE 111, graduate standing in engineering or physical science, or consent of instructor.

Course Description:
People spend most of their time indoors. Levels of many pollutants are higher indoors than in outdoor air. Better design and operation of buildings can considerably improve public health. Furthermore, enormous quantities of natural resources are used in constructing, operating, and maintaining buildings. Consequently, changes in building design and operation can also impact the natural environment, either adversely or beneficially.

In this class, we will study air pollutants in indoor environments, such as private residences, offices, schools, and public buildings. We will consider the factors that govern indoor pollutant concentrations, including ventilation. We will embark on a detailed exploration of the characteristics, consequences, and control of several pollutant classes, such as radon, toxic organic gases, combustion byproducts, and microorganisms such as molds and infectious bacteria. We will frame our study by an exploration of public policy related to indoor air.

Specific Topics
Concepts and tools: exposure, material-balance models, statistical models
Ventilation
Indoor air pollution from outdoor sources: particulate matter and ozone
Combustion byproducts
Radon and its decay products: lung cancer
Volatile organic compounds: odors and sick-building syndrome
Humidity
Bioaerosols: infectious disease transmission & asthma
Special indoor environments: airliner passenger cabins; museums
Measurement methods
Control technologies
Control strategies
IAQ policy issues: sustainability; indoor air quality as a basic human right

References:

• *Texts* The required "texts" are two readers. One contains 15 journal articles and is known as the "CE 109 Readings." The other contains notes, references, figures, tables, etc. to be discussed in lecture; it is known as the "CE 109 Lecture Notes." Both are available at moderate cost (compared with a text) from Copy Central on Hearst.

• *Background*. Most of the basic scientific and engineering principles applied in this course are covered in the prerequisite class CE 111. If you did not take that class at Berkeley and are uncertain about your preparation, you may want to review the volume *Environmental Engineering Science* by WW Nazaroff (that's me!) and L Alvarez-Cohen (Wiley,2001). A copy will be available on reserve at the Kresge (Engineering) Library.

• *CE 109 Problem Solutions*. A copy of this notebook will be maintained on the reserve shelf of the Engineering Library. Solutions to problem assignments and exams will be posted in this notebook approximately one week after the due date.

• *Reference Books.* Several books on indoor air quality have been published in the past decade or so. In my opinion, all are too superficial for use as texts for a class at this level. But don't take my word for it, have a look yourself. This will give you a chance to practice using Gladis and Melvyl.

• *Journals*. The most exciting materials in indoor air quality are being presented at conferences and/or published in journals. The following journals contain much of the IAQ literature. "Current Contents" on Melvyl is a phenomenal resource for searching the literature for articles on topics of interest.

- *Indoor Air* (Engineering Library)
- *Atmospheric Environment* (Engineering Library)
- *American Industrial Hygiene Association Journal* (Public Health Library)
- *Environmental Science & Technology* (Chemistry & Public Health Libraries)
- *Environment International* (Geology & Geophysics Library)
- *Journal of the Air & Waste Management Association* (Eng'ring & Pub. Health Libraries)

Grading:

Six ordinary engineering problem assignments will be made during the course. These will consist of exercises in indoor air quality engineering and analysis. In addition, each student is required to participate in two other activities: a technology assessment and a symposium. Each of these will involve a small-group study of an indoor air quality topic culminating in an oral presentation before the class. One midterm examination plus a final exam will also be held. The examinations will cover (a) readings, (b) lecture material, and (c) problem assignments. The weighting scheme for determining the final grade is as follows:

Problem assignments 1-6:	20%
Technology assessment:	15%
Symposium presentation:	15%
Midterm exam:	15%
Final examination:	35%

Assignments:

1. **Schedule**: Problem assignments will be due at 4 PM, usually on Mondays. Assignments may be submitted in class, or placed in the wooden box outside 633 Davis. You will be given 1-2 weeks for each assignment.
2. **Late Work**: You are encouraged to submit your work on time. However, during the semester, you may turn in one assignment late by up to one week without penalty. Assignments submitted more than one week late and the second or subsequent assignment submitted at all late will not be graded. Exceptions can be granted only in the case of illness or for equivalent extenuating circumstances.
3. **Collaboration**: The work you submit is to be your own. If, after making an attempt at solving a problem, you are stuck, you may consult with the instructor (during office hours, please). You may also talk over the problem with other students in the class. But you may not examine the written work of another student. This rule is designed to reflect the situation you will most likely face in professional practice: there will be experts with whom you can consult on tough or new aspects of a problem, but ultimately, you will be expected to make independent contributions to its solution.
4. **Format**: The purpose of the problem sets in this class is to give you practice in (a) solving problems that arise in indoor air-quality engineering, and (b) communicating results to others. To promote the latter goal, your grade for each problem will be based in part on how clearly you present your work. The following approach is recommended in preparing papers:
   I. Restate the objective of the problem - many errors arise from not understanding what a problem asks.
   II. Identify the physical setting of the problem
      a. If appropriate, draw a figure of the system, and label the dimensions, axes, and list other important parameters. If a picture is not appropriate, give a brief statement of the physical setting (e.g., an air volume over an urban air basin into which nitrogen oxides and hydrocarbons are emitted.)
      b. Differentiate among the information that is given by the problem statement, information that you obtain from other sources, and your assumptions.
   III. Solve the problem, showing all assumptions, without skipping steps, and including a brief running commentary. Circle all answers and call attention to important intermediate results.
   IV. Discuss briefly the significance of the results.

Assignment and Exam Schedule (Tentative)

22 January	PS #0 due
29 January	PS #1 due
5 February	PS #2 due
12 February	PS #3 due
26 February	PS #4 due
5 March	midterm exam
19 March	technology assessment presentation
9 April	PS #5 due
30 April	symposium presentations
7 May	PS #6 due
18 May	final exam