

# CE 597/EEE 595: Indoor Air Quality

## Spring 2017

**Lectures:** Tuesday & Thursday 12:00-13:15 - HAMP 2107

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**Web:** Piazza Course Homepage: <https://piazza.com/purdue/spring2017/ce597eee595/home>

**Office Hours:** Tuesday & Thursday: 13:15-14:30 or by appointment.

**Prerequisites:** Graduate standing with an undergraduate degree in engineering or consent of instructor. Qualified undergraduate students may enroll with consent of instructor.

### Course Objectives

By taking this course you will be able to:

1. Mechanistically evaluate pollutant transport dynamics in buildings through application of material-balance models.
2. Apply fundamental principles of aerosol physics to characterize the behavior of indoor aerosols from several nanometers to tens of micrometers in size.
3. Evaluate human exposure to indoor aerosols and analyze the effectiveness of engineering control strategies for indoor air pollution.
4. Read and critically analyze papers in the technical literature on indoor air quality (IAQ) and aerosols.
5. Gain additional insight regarding specific topics related to indoor air quality and aerosols through a rigorous course project.
6. Analyze, and discuss in a group-setting, contemporary IAQ issues facing our global society.
7. Prepare and review written and oral technical communication.

### Textbook - Required

Hinds, W.C. (1999). *Aerosol Technology: Properties, Behavior, and Measurement of Airborne Particles*, 2nd Edition. Wiley.

### Additional References

Friedlander, S.K. (2000). *Smoke, Dust, and Haze: Fundamentals of Aerosol Dynamics*, 2nd Edition. Oxford [Online access available through Purdue Libraries].

Kulkarni, P., Baron, P.A., and Willeke, K. (Eds.) (2011). *Aerosol Measurement: Principles, Techniques, and Applications*, 3rd Edition. Wiley [Online access available through Purdue Libraries].

Seinfeld, J.H. and Pandis, S.N. (2006). *Atmospheric Chemistry & Physics: From Air Pollution to Climate Change*, 2nd Edition. Wiley.

Nazaroff, W.W. and Alvarez-Cohen, L. (2001). *Environmental Engineering Science*. Wiley.

## **Grading**

The overall course grade will be weighted as follows:

Homework Assignments: 35%

Take-Home Exam: 15%

Course Project: 40%

Readings & Discussions on Contemporary IAQ Issues: 10%

## **Attendance**

Regular attendance and participation are essential and expected. If you are unable to attend a lecture due to illness, personal or family emergency, or observance of a holiday, please contact me via e-mail.

## **Homework Assignments**

There will be three homework assignments over the course of the semester. All assignments are due at the beginning of class for the assigned day. Homework assignments should be completed individually. Students may submit their assignment in the form of an electronic PDF (prepared in Microsoft Word or L<sup>A</sup>T<sub>E</sub>X, filename: LastName\_FirstName\_HW\_No.pdf) or a hardcopy (handwriting should be neat, legible, and organized and papers should be stapled in the upper lefthand corner). Students are encouraged to use MATLAB and Microsoft Excel to complete their assignments.

## **Take-Home Exam**

There will be one 48-hour take-home exam in this course, tentatively scheduled for March 30, 2017.

## **Course Project**

You will work in teams to investigate any one of several topics relevant to the course. You will be able to choose from a list of topics provided by the instructor, or you may propose your own topic (with permission from the instructor). The project will include several deliverables to be submitted throughout the semester. Students are expected to complete a rigorous study of the topic (including a review of existing literature), prepare a final written report of the findings in the form of a 10 to 12 page conference/journal paper, and give an oral presentation to your classmates during the last week of the semester. You are expected to integrate course material to complete the course project and to demonstrate a firm understanding of project materials as reflected in the final written report and oral presentation.

## **Readings & Discussions on Contemporary IAQ Issues**

The second half of each Thursday lecture, approximately 35 minutes, will be devoted to small-group discussions of various IAQ topics, listed below. You will have one week to read an assigned paper on the given topic, which you will then discuss with a group of three to four other students in class. Guided discussion questions will be handed out with each paper. Each group will then briefly present their paper to the rest of the class. You may use the blackboard to illustrate key points. The aim of these assignments are to encourage you to think about IAQ issues in a broader scientific and societal context, introduce you to the writings of leading experts in the field, and give you practice discussing technical literature with your peers.

1. Biomass Cookstoves: IAQ in a Global Context
2. Climate Change & IAQ

3. Microbiology of the Built Environment
4. Indoor Nanoparticles: Sources & Exposure
5. Emerging Air Cleaning Technologies

### **Academic Dishonesty**

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty" [Part 5, Section III-B-2-a, University Regulations]. Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest" [University Senate Document 72-18, December 15, 1972].

### **Grief Absence Policy for Students**

Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missing assignments or assessments in the event of the death of a member of the student's family.

### **Students with Disabilities**

If you have a disability that requires special academic accommodation, please make an appointment to speak with me during the first week of the semester in order to discuss any adjustments. It is the student's responsibility to notify the Disability Resource Center <http://www.purdue.edu/drc> of an impairment/condition that may require accommodations and/or classroom modifications.

### **Emergencies**

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on Piazza or can be obtained by contacting me via e-mail.

### **Nondiscrimination**

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable

federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit <http://www.purdue.edu/report-hate> to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

*Note: This syllabus is subject to change. Current version: January 15, 2017.*

Course Outline [Updated: January 15, 2017]

Lectures	Days	Topics Covered	Textbook Reading	Assignments
1-2	Jan. 17, 19	Course introduction & project overview, indoor aerosols & gases, the material-balance principle		
3-6	Jan. 24, 26, 31, Feb. 2	Material-balance models for buildings		Jan. 31: HW1 assigned
7-9	Feb. 7, 9, 14	Particle size distributions	S&P Ch.8*	
10-13	Feb. 16, 21, 23, 28	Properties of gases, rectilinear particle motion, particle size definitions, inertial impaction	Hinds Ch. 2, 3, 5	Feb. 16: HW1 due, HW2 assigned. Feb. 23: Project justification due.
14-15	Mar. 2, 7	Brownian motion & diffusion	Hinds Ch. 7	Mar. 7: HW2 due, HW3 assigned
Spring Vacation: Mar.13-18				
16-17	Mar. 9, 21	Particle deposition to indoor surfaces		
18-19	Mar. 23, 28	Adhesion & resuspension		Mar. 23: HW3 due.
20-21	Mar. 30, Apr. 4	Filtration & air cleaning	Hinds Ch. 9	Mar. 30: Take-home exam (48 h)
22-24	Apr. 6, 11, 13	Exposure assessment, intake fraction & lung deposition models		Apr. 6: Project analysis plan due.
25-26	Apr. 18, 20	Nucleation, condensation & coagulation		Apr. 18: Project literature review due
27-28	Apr. 25, 27	Course project presentations		May 2: Final project report due

\*Chapter 8 from Seinfeld & Pandis (S&P) will be posted to Piazza.