ENVE 576: Indoor Air Pollution
Illinois Institute of Technology
Department of Civil, Architectural and Environmental Engineering

Spring 2013
3 credit hours

Course Unique Number(s)
ENVE 576 Section 1: 24899 (graduate) | ENVE 576 Section 2: 25173 (graduate online)

Classroom and Meeting Time
Stuart Building, Room 239, Tuesdays 5:00 PM – 7:40 PM

Course Website
http://built-envi.com/courses/enve-576-iap-sp13/

Prerequisites
ENVE 405 or ENVE 520 Environmental Monitoring and Assessment (flexible)

Instructor
Brent Stephens, Ph.D.
Assistant Professor, CAEE
Office: Alumni Memorial Hall Room 212
Phone: (312) 567-3356
Email: brent@iit.edu
Website: www.built-envi.com

Office Hours
Office hours are by appointment. I am generally around my office, Alumni Hall Room 212, most of the day Monday through Friday, and you can always stop by. To ensure that I will be there, please email me to schedule an appointment.

Course Catalog Description
Indoor air pollution sources, indoor pollutant levels, monitoring instruments and designs; indoor pollution control strategies: source control, control equipment and ventilation; energy conservation and indoor air pollution; exposure studies and population time budgets; effects of indoor air population; risk analysis; models for predicting source emission rates and their impact on indoor air environments.

Course Objectives
To introduce students to important concepts of indoor airborne pollutants, including their physical and chemical properties, emission sources, and removal mechanisms. By taking this course students will be able to:
1. Describe particle-phase, gas-phase, and biological pollutants found in indoor environments
2. Model indoor pollutant emission, transport, and control
3. Manipulate and perform calculations with aerosol distributions and gas-phase compounds
4. Analyze indoor pollutant control technologies and determine their effectiveness
5. Read and critically analyze articles in the technical literature on indoor air pollution
6. Prepare and review written and oral technical communication

Textbook
There is no required textbook for this course. We will rely on peer-reviewed literature and handouts from reference texts for the majority of our topics. Reference texts include the following:

**Homework Assignments**
There will be 5 homework assignments during the course that will involve hand calculations and development of spreadsheets. Some general rules for homework assignments are as follows:
- Homework (HW) assignments will be posted on blackboard
- HW assignments will typically be due one week after they are assigned
- Students should submit neatly printed HW
- Hard copies of multiple page submissions must have all pages stapled together
- Students enrolled in the online course will submit HW via the Blackboard digital drop box. Handwritten HW must be scanned and converted to PDF by online students. Multiple pages must be converted to a single PDF for submission.

**Exams**
One take-home exam will be given with a tentative date of March 26, 2013. Students will have one week to complete the exam and return to Dr. Stephens, tentatively scheduled for April 2, 2013. A final exam is not scheduled for this course. A final report and presentation is currently scheduled to take place during the scheduled final exam period.

**Projects**
There will be one major research project in this course in lieu of a final exam. This final project is a research project where students research an indoor air pollution issue. Students will develop a technical research report describing their motivation, literature review, methods, and results, and will summarize their research with a classroom presentation at the end of the semester. Graduate students are expected to perform a more detailed analysis and format their report as a more formal research article/conference paper.

**Grading**
Course grading will be done primarily through homework assignments, one exam, and one project. This is a graduate course; higher expectations will be placed upon deliverables from graduate students than any undergraduate students that may enroll in the course. Grades will be determined by the total number of points accumulated through homework assignments, projects, and exams, with a small amount of potential credit for class participation. The total number of points available in each category is listed in the table below. The number of required points for various grades is also given below.

**Grading Table**

<table>
<thead>
<tr>
<th>Category</th>
<th>Available Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>300 (30%)</td>
</tr>
<tr>
<td>Take-home exam</td>
<td>300 (30%)</td>
</tr>
<tr>
<td>Final project</td>
<td>400 (40%)</td>
</tr>
<tr>
<td>Total</td>
<td>1000 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Required Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$\geq 900$ (90%)</td>
</tr>
<tr>
<td>B</td>
<td>800-899 (80-89.9%)</td>
</tr>
<tr>
<td>C</td>
<td>700-799 (70-79.9%)</td>
</tr>
<tr>
<td>D or below</td>
<td>$&lt;699$ (&lt;69.9%)</td>
</tr>
</tbody>
</table>
**Tentative Course Schedule (Updated April 15, 2013)**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture Topics</th>
<th>Reading*</th>
<th>Assignment:</th>
</tr>
</thead>
</table>
| 1    | Jan 15| Introduction to topic/field  
• Time activity and human exposure  
• Indoor and outdoor atmospheres  
• Fundamental air principles    | 1–3      |             |
| 2    | Jan 22| Reactor models  
• Steady-state and dynamic  
Ventilation and air exchange rates  
Human exposure patterns  
• Inhalation and intake fractions | 4–6      |             |
| 3    | Jan 29| Overview of indoor pollutants  
• Particulate matter  
• Gas-phase compounds  
⇒ Organic and inorganic  
• Biological | 7        | HW1 due     |
| 4    | Feb 5 | Gaseous pollutants  
• Sources  
• Emission models | 8–11     |             |
| 5    | Feb 12| Gaseous pollutants  
• Adsorption/desorption  
• Reactive surface deposition  
• Homogenous chemistry  
• Byproduct formation (incl. SOA) | 12–14    | HW2 due     |
| 6    | Feb 19| Particulate matter  
• Single particle physics  
• Particle size distributions  
• Respiratory deposition | 15–17    |             |
| 7    | Feb 26| Particulate matter  
• Particle sources (indoor and outdoor)  
• Deposition and resuspension | 18–20    | HW3 due     |
| n/a  | Mar 5 | *Postponed lecture for family emergency* |          |             |
| 8    | Mar 12| Particulate matter  
• Filtration and air cleaners | 21–23    | HW4 due     |
| n/a  | Mar 19| *No class - Spring break* |          |             |
| 9    | Mar 26| Particulate matter  
• Penetration/infiltration | Exam assigned |             |
| 10   | April 2| SVOCs  
Health effects  
• Epidemiology and physical responses | 24,25,26,27 | Exam due   |
| 11   | April 9| (guest)  
Guest lecturer:  
Biological pollutants  
Measurement technologies |          |             |
| 12   | April 16| Developing countries | 28–30    | HW5 due     |
| 13   | April 23| Infectious disease transmission  
Applications  
• Standards and manufacturer ratings  
• Software | 31–33    |            |
| 14   | April 30| Final presentations | Final project due |             |
| Final| TBD   | No final exam |          |             |

*Suggested readings are listed on the following page. These readings are not required unless stated otherwise.*
Suggested Readings:


Other Course Information

Contribution to Meeting Curriculum Areas (ABET)

<table>
<thead>
<tr>
<th>Curriculum Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Science &amp; Math</td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Sciences</td>
<td></td>
</tr>
<tr>
<td>Basic Engineering</td>
<td></td>
</tr>
<tr>
<td>Introductory Environmental Engineering</td>
<td></td>
</tr>
<tr>
<td>Professional Level Environmental Engineering</td>
<td>100%</td>
</tr>
</tbody>
</table>

Learning Outcomes and Expected Knowledge Gain

Students will learn important concepts of indoor airborne pollutants, including their physical and chemical properties, emission sources, and removal mechanisms. By taking this course students will be able to describe particle-phase, gas-phase, and biological pollutants found in indoor environments; model indoor pollutant emission, transport, and control; analyze indoor pollutant control technologies and determine their effectiveness; and read and critically analyze articles in the technical literature on indoor air pollution.

Performance Indicators

Performance indicators used in student learning outcomes are marked with ‘X’ in the following table.

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Presentation by students (oral, poster, PowerPoint, etc.)</td>
<td>X</td>
</tr>
<tr>
<td>II</td>
<td>Term papers</td>
<td>X</td>
</tr>
<tr>
<td>III</td>
<td>Group projects (periodic progress reports project final report are required)</td>
<td>X</td>
</tr>
<tr>
<td>IV</td>
<td>Presentation by outside speakers on contemporary topics</td>
<td>X</td>
</tr>
<tr>
<td>V</td>
<td>Ethics, presentation and case study discussions</td>
<td>X</td>
</tr>
<tr>
<td>VI</td>
<td>Reports (lab report, summary report on design of experiment, data analysis, research findings, etc.)</td>
<td>X</td>
</tr>
<tr>
<td>VII</td>
<td>Group discussions on understanding of profession, liabilities, professional development, etc.</td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>Evaluation of students’ work through interviews, one-to-one meetings with students, and class discussions</td>
<td>X</td>
</tr>
<tr>
<td>IX</td>
<td>Review of learning outcomes with students and quiz on specific program learning outcomes</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Overall performance in exams, homework, projects, attendance, etc.</td>
<td>X</td>
</tr>
</tbody>
</table>

Personal Problems

If you have illness or personal problems that will affect your performance during the course of the semester, please let me know as soon as possible. “After the fact” provides little protection unless there are extreme circumstances. Contact me by phone or e-mail at any time.

Students with Disabilities

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources. The Center for Disability Resources (CDR) is located in Life Sciences Room 218, telephone (312) 567-5744 or email: disabilities@iit.edu.
### Relationship of Course to ABET Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Description</th>
<th>Extent of Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Apply knowledge of math, engineering, science</td>
<td>3</td>
</tr>
<tr>
<td>b1</td>
<td>Design and conduct experiments</td>
<td>2</td>
</tr>
<tr>
<td>b2</td>
<td>Analyze and interpret data</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
<td>4</td>
</tr>
<tr>
<td>d</td>
<td>An ability to function on multi-disciplinary teams</td>
<td>2</td>
</tr>
<tr>
<td>e</td>
<td>An ability to identify, formulate, and solve engineering problems</td>
<td>5</td>
</tr>
<tr>
<td>f</td>
<td>A respect for, and understanding, the professional and ethical responsibility</td>
<td>1</td>
</tr>
<tr>
<td>g</td>
<td>An ability to communicate effectively</td>
<td>4</td>
</tr>
<tr>
<td>h</td>
<td>The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>4</td>
</tr>
<tr>
<td>i</td>
<td>A recognition of the need for, and an ability to engage in life-long and continuing education</td>
<td>2</td>
</tr>
<tr>
<td>j</td>
<td>A knowledge of contemporary issues within civil engineering</td>
<td>3</td>
</tr>
<tr>
<td>k</td>
<td>An ability to use techniques, skills, and tools in engineering practice</td>
<td>4</td>
</tr>
<tr>
<td>l</td>
<td>Ability to use knowledge gained in courses in a major capstone design project</td>
<td>4</td>
</tr>
</tbody>
</table>

1 = minimum coverage in the course; 5 = major coverage in the course

### Academic Honesty


You must submit your own work for homework. You are encouraged to discuss and even work with other students on homework (unless explicitly told otherwise), but material that is submitted must be your own work. For group project assignments, each group is to submit their own work. For a first violation of the IIT Code of Academic Honesty for a homework or project, the homework will receive a grade of zero for all involved students and the students will be reported to the Designated Dean for Academic Discipline (DDAD). For a first violation of the Code of Academic Honesty for a major project or an examination, the student will receive a failing grade for the course and the student will be reported to the DDAD. For a second violation, the student will receive also failing grade for the course and be reported to the DDAD.